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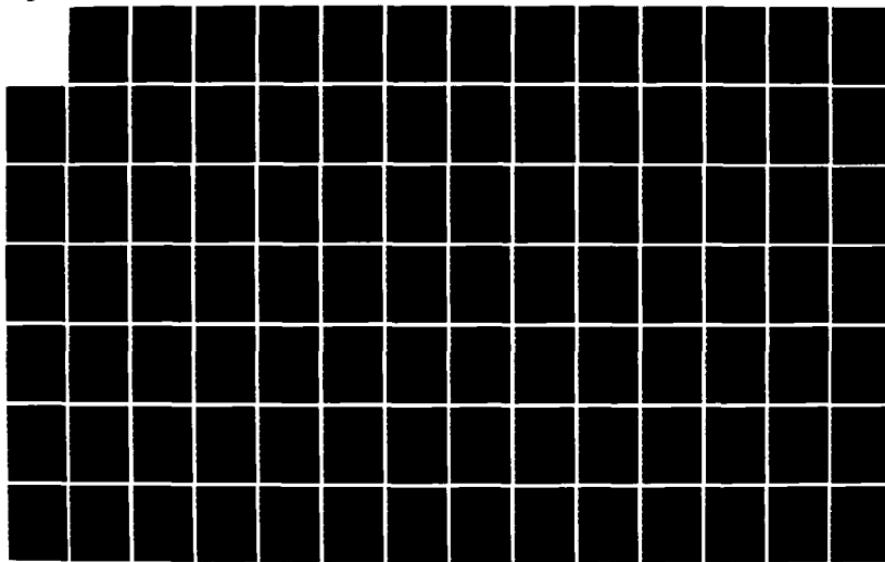
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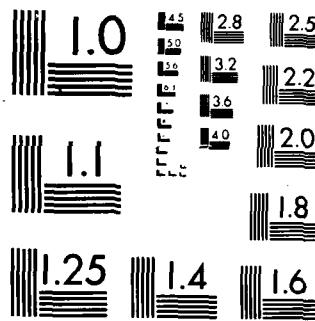
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AN EXPLORATORY STUDY OF INDIVIDUAL AND  
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IN RESEARCH AND DEVELOPMENT ORGANIZATIONS  
WITHIN AIR FORCE SYSTEMS COMMAND

THESIS

Robert A. Eaton  
Captain, USAF

AFIT/GSM/LSY/86S-6

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AN EXPLORATORY STUDY OF  
INDIVIDUAL AND ORGANIZATIONAL VARIABLE INTERRELATIONSHIPS  
IN RESEARCH AND DEVELOPMENT ORGANIZATIONS  
WITHIN AIR FORCE SYSTEMS COMMAND

THESIS

Presented to the Faculty of the School of Systems and Logistics  
of the Air Force Institute of Technology  
Air University  
In Partial Fulfillment of the  
Requirements for the Degree of  
Master of Science in Systems Management

Robert A. Eaton, B.S.

Captain, USAF

September 1986

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### Preface

The purpose of this study was to examine the interactions of selected organizational variables in research and development (R&D) organizations in the Department of Defense (DOD). A better understanding of these interactions may help R&D organizations do a better job of managing their human and financial resources.

A model was proposed that predicted the interrelationships between these variables. Data from an existing data base was analyzed and several significant relationships were discovered. Based on these results, the model was amended and several fruitful areas for future research were identified. The performance of R&D organizations in the DOD may improve if the recommendations proposed by this study are implemented.

I want to express my appreciation to those whose help and encouragement were instrumental in the completion of this thesis. I am thankful to my faculty advisor, Captain Tom Triscari, for his guidance and assistance throughout the entire thesis process. I want to express my love and gratitude to my wife Cathie and our daughters Jenny and Lizzie for their patience and understanding when thesis demands cut into our family time. Finally, I want to thank God for giving me strength and hope and for reminding me what is truly important in this life.

Robert A. Eaton

### Table of Contents

	Page
Preface . . . . .	ii
List of Figures . . . . .	v
List of Tables . . . . .	vi
Abstract . . . . .	viii
I. Introduction . . . . .	1
Problem Statement . . . . .	1
Background . . . . .	2
Scope of the Research . . . . .	2
II. Literature Review . . . . .	4
Introduction . . . . .	4
Personality Type . . . . .	5
Organizational Structure . . . . .	10
Organizational Communication Flow . . . . .	13
Organizational Effectiveness . . . . .	16
Research and Development Organizations . . . . .	18
Summary . . . . .	19
III. Research Hypotheses . . . . .	20
Introduction . . . . .	20
Personality Type and Structure . . . . .	21
Personality Type and Communication Flow . . . . .	22
Structure and Communication Flow . . . . .	22
Structure and Effectiveness . . . . .	23
Communication Flow and Effectiveness . . . . .	24
Personality Type and Effectiveness . . . . .	24
Summary . . . . .	25
IV. Research Methodology . . . . .	26
Introduction . . . . .	26
Data Collection . . . . .	26
Data Analysis . . . . .	32
Summary . . . . .	35

	Page
V. Research Results . . . . .	36
Introduction . . . . .	36
Hypothesis #1 . . . . .	36
Hypothesis #2 . . . . .	37
Hypothesis #3 . . . . .	39
Hypothesis #4 . . . . .	40
Hypothesis #5 . . . . .	41
Hypothesis #6 . . . . .	42
Summary . . . . .	43
VI. Discussion and Conclusions . . . . .	44
Introduction . . . . .	44
Personality Type and Structure . . . . .	45
Personality Type and Communication Flow . . . . .	46
Structure and Communication Flow . . . . .	48
Structure and Effectiveness . . . . .	52
Communication Flow and Effectiveness . . . . .	54
Personality Type and Effectiveness . . . . .	57
Amended Model . . . . .	58
Limitations of the Research . . . . .	59
Recommendations . . . . .	60
Appendix A: Unit Member Survey . . . . .	63
Appendix B: Evaluator Survey . . . . .	78
Appendix C: Version of MBTI Questionnaire . . . . .	81
Bibliography . . . . .	85
Vita . . . . .	88

List of Figures

Figure	Page
1. Interrelationships Among Variables in R&D Organizations . . . . .	5
2. Systems View of Research Hypotheses . . . . . . . . . . . . . . . . . . .	20
3. Hypothesized Relationships Among Variables . . . . . . . . . . . . . . . . .	44
4. Amended Model of Relationships Among Variables . . . . . . . . . . .	58

List of Tables

Table		Page
I.	Identification and Location of Data Collection Sites . . .	29
II.	Summary of R&D Work Units Surveyed . . . . .	30
III.	Summary of Major Variables and Associated Dimensions . .	31
IV.	Summary of Work Unit Supervisors' Personality Types . . .	33
V.	ANOVA Table: Structure by Personality Type . . . . .	36
VI.	Structure of Selected Personality Types . . . . .	37
VII.	ANOVA Table: Information Specificity from Work Unit by Personality Type . . . . .	38
VIII.	Information Specificity of Selected Personality Types . .	38
IX.	ANOVA Table: Information Accuracy from Work Unit by Personality Type . . . . .	39
X.	Information Accuracy of Selected Personality Types . . .	39
XI.	Correlation Matrix: Structure by PERCT3 . . . . .	40
XII.	Correlation Matrix: Structure by UFFECT . . . . .	41
XIII.	Correlation Matrix: INFQUAL2 by UFFECT, E2, E4, E5, E7, and E9 . . . . .	42
XIV.	ANOVA Table: Effectiveness by Personality Type . . . . .	42
XV.	Effectiveness of Selected Personality Types . . . . .	43
XVI.	Structure of All Personality Types . . . . .	45
XVII.	F Probabilities: Structure by Personality Type . . . . .	45
XVIII.	F Probabilities: Communication Flow by Personality Type . . . . .	47
XIX.	Correlation Matrix: Structure by PERCT1, PERCT3 . . . . .	49
XX.	Correlation Matrix: Structure by Information Accessibility . . . . .	49
XXI.	Correlations Between Structure and Information Quality . . . . .	50

	Page
XXII. Correlations Between Structure and Effectiveness . . . . .	53
XXIII. Correlations Between Information Accuracy and Effectiveness . . . . .	55
XXIV. Correlations Between Information Reliability and Effectiveness . . . . .	56
XXV. F Probabilities: Effectiveness by Personality Type . . . .	57

### Abstract

This investigation examined the interrelationships between four variables in research and development organizations within Air Force Systems Command. The four variables were the work unit supervisor's personality type, work unit structure, work unit communication flow, and work unit effectiveness. Data reduction was performed on an existing data base and 31 work units were identified. Values for the four variables were computed for each of the 31 work units.

A one-way analysis of variance was performed in order to look for significant differences in structure, communication flow, or effectiveness between different supervisor personality types. Significant differences were discovered between sensing types and intuitive types in the structure of their work units and in the quality of information received by their work units. In addition, significant differences were noted between thinking types and feeling types in the effectiveness of their work units. These findings may provide guidance for selecting managers in research and development organizations.

A Pearson correlation analysis was performed to look for significant relationships between structure, communication flow, and effectiveness. Significant relationships were noted between a work unit's structure and the quality of information it receives, and its access to that information. Also discovered were significant relationships between a work unit's structure and its effectiveness, and between a work unit's information quality and its effectiveness. These findings may prove useful in the design and redesign of research and development organizations.

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I. Introduction

Problem Statement

Organizations are an integral part of people's lives. Most people belong to organizations for work or social reasons, and regularly deal with organizations as customers or clients. According to Gibson, the primary justification for the existence of organizations is that certain goals can only be achieved through the organized efforts of groups of people (12:4).

A unique type of organization is the research and development (R&D) organization. R&D organizations are critical to society's welfare and consume vast amounts of resources. The source of funding for a majority of the research and development organizations in the United States is the federal government (4:4). Because organizations, especially R&D organizations, have such a profound effect on society, it is important that they be studied and understood. Armed with an increased understanding of their organizations, managers can more effectively perform their functions of planning, organizing, and controlling (12:3!).

the variables were compared against each other, they were broken down into their respective dimensions in order to yield more detailed results.

## II. Literature Review

### Introduction

Organizations play a large part in people's lives. Most people are members of organizations in a work or social setting, or regularly deal with organizations as clients or customers. The primary reason for the existence of organizations is that some goals can be achieved only through the organized efforts of groups of people (12:4). Because organizations have such a profound influence on our society, it is important that they be studied and understood.

There are many variables involved in the makeup of an organization. Gibson (12:5-6) classifies these variables into three broad characteristics common to all organizations: behavior, structure and processes. Behaviors are what people bring with them (such as needs, personality, and attitudes) when they become part of an organization structure. Within this organization structure, these people engage in the processes of communication and decision making.

This research focused on four important organizational variables: work unit supervisor's personality type (behavior), work unit structure (structure), work unit communication flow (process), and work unit effectiveness. Personality type deserved special attention because it is an important determinant of the work unit supervisor's orientation toward the organization (38:967). Structure is an important variable because it affects how organizational processes, such as communication and decision making, will be carried out (12:227). Communication flow was examined because it is the process by which managers accomplish

their task responsibilities in an organization (31:493). Effectiveness is important because it is a major measurement of the performance of an organization (31:14).

These four variables were examined in the context of a research and development (R&D) organization. R&D organizations are critical to society's welfare and consume huge amounts of resources, funded largely by the federal government (4:4). The interrelationships of these variables in an R&D context can be seen in Figure 1.

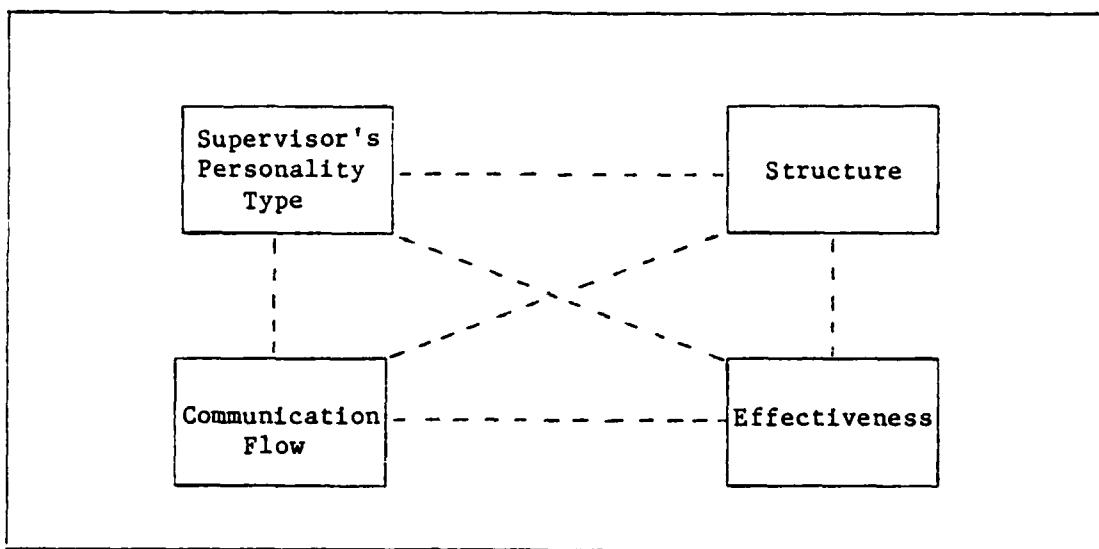


Figure 1. Interrelationships Among Variables in R&D Organizations

#### Personality Type

One of the variables that is involved in the makeup of a research and development organization is the personality type of the work unit supervisors. Zmud defines personality as "the cognitive and affective structures maintained by individuals to facilitate their adjustments to the events, people, and situations encountered in life" (38:967). An

approach that is commonly used in determining personality type is measuring the individuals' preferences by asking them what they like to do and how they would respond in certain situations (29:379). One such instrument for measuring personality type is the Myers-Briggs Type Indicator (MBTI).

Myers-Briggs Type Indicator. The Myers-Briggs Type Indicator was developed by Isabel Myers and her mother Katharine Briggs in 1942 in order to measure an individual's psychological type (22:xiii). The MBTI incorporates the psychological types introduced by Carl Jung in the early 1900's (29:379). These psychological types reflect the different ways that individuals prefer to use their minds, specifically in the way that they perceive and in the way that they make judgments. Perceiving is the process of becoming aware of people, things, ideas, and occurrences. Judging is the process of arriving at conclusions about what has been perceived. Together, perception and judgment govern much of a person's external behavior (22:1). For example, Robey and Taggart (29:375) proposed that human information processing tendencies can be measured by self-description inventories such as the MBTI.

There are two methods of perceiving: sensing and intuition. Sensing is the process of becoming aware of things through the use of the five senses (22:2). The sensing person deals in facts and tends to be very practical (16:17). Intuition, on the other hand, involves the ideas and associations that the unconscious adds to external perceptions. These unconscious contributions can range from a simple hunch to an important scientific breakthrough (22:2). Intuitive people

tend to think of themselves as innovative and enjoy working with possibilities rather than facts. The differences between sensing types and intuitive types is the source of a great deal of conflict, misunderstanding, and misinformation. In general, 75% of the general population indicates a preference for sensing and 25% reports a preference for intuition (16:16-17). In MBTI notation, the sensing preference is designated as S and the intuition preference is designated as N (22:3).

There are also two methods of judging: thinking and feeling. Thinking types approach decision making with an objective and impersonal attitude whereas feeling types have a more subjective and personal attitude (22:3). There is a slight difference between the sexes in this area, with 60% of the men claiming to be thinking types and 60% of the women claiming to be feeling types (16:20). In MBTI notation, the thinking preference is designated as T and the feeling preference is designated as F (22:4).

The perceiving preference (S or N) and judging preference (T or F) are completely independent of each other, and can therefore be combined to form four combinations: ST, SF, NF, or NT. Each of these combinations results in a different type of personality, with different interests, values, and needs (22:4).

ST Combination. ST personalities rely primarily on sensing in their perception and thinking in their judging. They focus their attention on facts and make decisions based on impersonal analysis of the facts (22:5). To an ST, the ideal organization is one that "emphasizes factual details, the physical features of work, impersonal

organizational control, certainty and specificity" (29:379). Usually practical and matter of fact, ST's are especially suited for careers in accounting, banking and finance and commerce (22:159). ST's also tend to have a low tolerance for risk in making decisions (29:380).

SF Combination. SF personalities also rely primarily on sensing in their perception, but prefer to use feeling in their judging. Although they focus on facts, they are more interested in facts about people than in facts about things, and they approach decision making with personal warmth (22:5-6). SF's tend to be sympathetic and friendly, and enjoy "helping" occupations such as customer relations, nursing, or education (22:159). They also tolerate a greater degree of risk in decision-making than other personality types (29:380).

NF Combination. NF people focus their attention on possibilities rather than facts, and approach decision making with personal warmth. Usually enthusiastic and insightful, they are successful in communicating their ideas to others. They are commonly found among creative writers, theologians, counselors, and health-related professionals (22:160). For the NF type, the organization's purpose is to serve mankind (29:380).

NT Combination. NT people also focus on possibilities, but approach decision making in an impersonal manner. Often logical and ingenious, they are most successful in solving problems in a field of special interest (22:6). Suitable careers for NT people include scientific research, mathematics, and law (22:159).

Personality Type and Communication. Sensing types and intuitive types differ in their communication preferences. Because they work more slowly and with greater attention to the facts, sensing types want everything spelled out to them in excruciating detail. This is especially true if they have low task knowledge or do not have access to decision aids (38:970). Intuitives, on the other hand, just want the highlights, and will become easily bored or annoyed if they are given all the details (22:59-60). Therefore, different personality types will probably utilize different communication channels based on the quantity and level of aggregation desired in their information. In addition, different approaches are required when communicating with different personality types. A person should use a logical and orderly approach to communicate with a thinking type, and express feelings and seek harmony when communicating with a feeling type (22:209).

Personality Type and Organizational Structure. The manager's personality type also has an effect on the structure of the organization. Bobbitt and Ford (5:19) proposed that decision makers design organizational structures based on their own personal orientations in conjunction with the organization's context. They also suggest that the opposite is true; that the organization's structure influences the behavior of the decision makers. Myers and Myers (22:164) found that sensing types prefer established ways of doing things and get impatient when details get complicated. Intuitives, however, dislike doing the same thing repeatedly and enjoy solving new problems and learning new things. This might indicate that sensing types favor a more mechanistically structured organization, in which

there is a high degree of job specialization, standardized rules and procedures, and centralized decision making. Intuitives, on the other hand, will usually favor a more organically structured organization, featuring less job specialization, fewer rules, and more participative decision making.

#### Organizational Structure

Another factor that affects a research and development organization is the work unit structure. Gibson defines structure as the "relatively fixed relationships that exist among the jobs in the organization" (12:227). Organizational structure can impede the creative process that is a critical element in any research and development organization (4:167). Donnelly lists three dimensions of organizational structure: complexity, formalization, and centralization (6:176).

Complexity. Complexity is the measure of the number of different occupational titles or functional specialties that are present in an organization. In other words, complexity measures the degree of job specialization in the organization. Although job specialization can lead to increased productivity in an organization, it can also make the supervisor's job more difficult due to the dissimilarities in the tasks of the work units and the workers in those units (6:176).

Formalization. Formalization, also called standardization, is the degree to which job expectations, rules, procedures, policies, and other sources of expected job behavior have been put in writing (6:176). Complexity and formalization often go hand-in-hand because specialized jobs lend themselves to clearly defined methods for

accomplishment. Simple, routine production and administrative tasks are often easily formalized, but non-routine research and development tasks are not amenable to formalization (6:177).

Centralization. Centralization is the measure of the distribution of decision-making power throughout the organization. It is more difficult to measure centralization than complexity or formalization because it is often not clear who made the final decision or who was involved in the decision-making process. Centralization can range from autocratic, where all decisions are made by the top manager, to democratic, where all decisions are made by all the members of the organization (6:177).

Organizations are usually complex, formal, and centralized, or simple, informal, and decentralized (6:179). Organizations that are complex, formal, and centralized are said to have a mechanistic structure, and organizations that are simple, informal, and decentralized are said to have an organic structure (21:225).

Factors Affecting Structure. There are many contextual factors that affect organizational design: the organization's age, the organization's size, technology used by the organization, environmental uncertainty, and the organization's strategic choice (6:196). Most research efforts have focused on size, technology, and environment (5:13). With regard to size, larger organizations tend to be more mechanistically structured than smaller organizations (6:196). This is because larger organizations usually have more specialized (complex) activities and more formalized procedures (31:264).

As for organizational technology, Woodward found that an organic structure is best for organizations utilizing unit and process production methods, and a mechanistic structure is best for organizations utilizing mass production methods (32:309). Unit and process production tasks require low levels of standardization (formalization) and specialization (complexity). Mass production tasks, on the other hand, require high levels of standardization and specialization (31:264).

In examining environmental uncertainty, Burns and Stalker found that a mechanistic structure is optimal in stable environments and an organic structure is optimal in turbulent environments (18:188). In a stable environment, an effective organization has highly specialized (complex) tasks and highly centralized decision making. However, an organization operating in a turbulent environment requires less specialized tasks and more decentralized decision making in order to meet the organization's changing needs (31:363).

According to Bobbitt and Ford (5:19), however, the relationship between contextual factors and organizational structure is not always direct and logical. They found that these contextual factors are merely bits of information that are used by the decision maker in deciding on an organizational structure. Therefore, the relationship between contextual factors and organizational structure varies because decision makers (i.e. managers) vary.

Structure and Communication. In their research, Hall and Ritchie (13:243) found that organizational structure was the main factor influencing the flow of technical communications. For example,

information is filtered out of upward communication as it goes through the many management levels of a mechanistic structure (12:227). There is also a tendency for top managers in a mechanistic organization to control and closely monitor all incoming and outgoing communications (15:121). On the other hand, organic organizations demonstrate a higher degree of lateral and open communications than do mechanistic organizations (15:121). In addition, structural factors often determine the choice of communication partners in an organization (28:38). Lawrence and Lorsch found that communications took place at a lateral, peer level for unstable organizations, but were more vertical for stable organizations (15:127).

In a study by O'Reilly and Roberts (26:674), most of the measures of structure were significantly associated with measures of information accuracy and communication openness. This may be because structure affects the ability to transmit the information necessary to coordinate activities and make decisions. In this same study, however, there was no significant relationship between structure and organizational effectiveness. Their evidence indicated that structure affects communication, which in turn affects effectiveness (26:675).

#### Organizational Communication Flow

Communication is a vital activity in the functioning of an organization. It is critical to the performance of the management functions of planning, organizing, and controlling (12:317). It is also the activity to which managers devote a great deal of their time (31:493). Farace defines communication as "the exchange of symbols that are commonly shared by the individuals involved, and which evoke

quite similar symbol-referent relationships in each individual" (10:26). These common symbols can be verbal or nonverbal (12:319).

The Communication Process. The communication process consists of five elements: the communicator, the message, the medium, the receiver, and feedback (12:318). The communicator can be any member of the organization who has information to share. This information must then be encoded into common symbols, which is the message. The medium carries the message to the receiver, where it must be decoded (12:320). The final element is feedback, which assures the communicator that the message has been received and properly understood. Another element that can be present during this process is noise. Noise is any factor that distorts the intended message (12:321).

Communication Directions. An organization should be designed to allow for communication in four directions: downward, upward, horizontal, and diagonal (12:321).

Downward. Downward communication goes from higher levels to lower levels in the organization. Examples of downward communication include job instructions, official memos, policy statements, and operating manuals. A certain amount of downward communication is necessary to reduce uncertainty (6:435).

Upward. Upward communication goes from lower levels to higher levels in the organization. Although it is difficult to achieve in large organizations, upward communication is a vital source of information to management and helps to ensure effective decision making. Examples of upward communications include suggestion boxes, group meetings, and grievance procedures (6:436).

Horizontal. Although upward and downward communication receive most of the attention in organizational design, horizontal communication is also needed. Horizontal communication is necessary in the coordination and integration of the diverse functions of the organization. Since there are no formal channels for horizontal communications in most organizations, individual managers must ensure that horizontal communication takes place (12:322).

Diagonal. The least used and least important of the communication directions, diagonal communication detours normal communication channels in order to save time and effort (6:437).

Communication and Effectiveness. O'Reilly and Roberts (26:678) found that communication openness and information accuracy are both related to organizational effectiveness. Other studies have shown that R&D organizations that permit members to communicate freely with each other reap the benefits in the form of quicker and more accurate decisions and high levels of job satisfaction (9:103). It has also been found that the availability of relevant information usually improves the accuracy of decisions (25:756). More accurate decisions should result in improved organizational effectiveness.

However, not all researchers agree on the relationship between communication and effectiveness. Allen claims that good communication results in good performance, but Frost and Whitley claim that good performance results in good communication (8:165-166). In addition, Tushman states that there is no relationship between high levels of communication and high levels of performance (34:490).

Communication in R&D Organizations. It is generally accepted that communication of technical information is an important characteristic of successful R&D organizations (36:103). This information enhances the organization's creativity in recognizing organizational needs and identifying the means to meet those needs (2:107). The best source of information is a colleague within the organization (1:2). However, external information sources are necessary to keep up with scientific and technological breakthroughs (27:170). This external information is often channeled into the organization by technological gatekeepers, who act as intermediaries between their organizational colleagues and the outside world (8:167). Research by Gerstberger and Allen (11:279) indicates that accessibility is the single most important determinant of how often an information source will be used.

R&D organizations must deal with varying degrees of uncertainty in their projects (35:43). Different communication networks deal with this uncertainty with varying levels of effectiveness. Therefore, there is no single best communication network for use in R&D organizations; instead, the optimal communication network will be contingent on the nature of the work performed by the R&D organization (35:45).

#### Organizational Effectiveness

Organizational performance can be measured in terms of efficiency and effectiveness. Efficiency measures the organization's ability to get things done correctly and focuses on input-output ratios (31:14). Effectiveness, on the other hand, measures the organization's ability to choose appropriate objectives and achieve those objectives (32:38).

Effectiveness reflects the entire input-process-output cycle. It must also reflect the relationship between the organization and its environment (12:64). According to Drucker, effectiveness is the key to the success of an organization (31:14).

Effectiveness refers to the optimal relationship between short run, intermediate run, and long run criteria. Production, efficiency, and satisfaction are criteria for evaluating short run effectiveness; adaptiveness and development are criteria for the intermediate range; and survival is a criterion for long run effectiveness. Gibson (12:65-66) describes these effectiveness criteria as follows:

Production. Production is the ability of the organization to produce the quantity and quality of output that the market demands. Examples of production measures include profit, sales, market share, students graduated, and customers served.

Efficiency. Efficiency is usually measured as a ratio of output to input. Examples of efficiency measures include rate of return on capital, cost per student, and unit cost.

Satisfaction. Satisfaction reflects how well the organization meets the needs of its employees. Examples of satisfaction measures include tardiness, absenteeism, turnover, and grievances.

Adaptiveness. Adaptiveness reflects how well an organization can and does respond to externally induced changes. There are no specific and concrete ways to measure adaptiveness other than to examine how the organization responds to an externally induced change.

Development. Development involves the organization investing in itself in order to enhance its chances for long term survival.

Training programs for managerial and nonmanagerial personnel is one example of organizational development.

Survival. Survival is the ultimate test of organizational effectiveness. It depends on the successful accomplishment of the short and intermediate run criteria.

#### Research and Development Organizations

R&D Management. Evans (9:21-25) states that the supervisor's role in an R&D organization is different than it is in other organizations. First, R&D workers have a more varied work schedule, which requires more managerial attention. Second, R&D workers often possess more technical knowledge than the supervisor, and this often puts the supervisor in a consultative role rather than a directive role. Third, R&D workers tend to better discipline themselves and are allowed much more freedom of movement and judgment than the average production worker. Fourth, R&D workers may often seek direction from outside experts, rather than the supervisor. Fifth, the nature of R&D work often calls for frequent worker reassessments or even work unit reorganization. Finally, R&D work often requires the supervisor to do the same work as the men he is supervising.

Based on these differences, Evans (9:30-32) concludes that the R&D supervisor's job involves acting more as a facilitator and encourager, rather than just giving orders. The R&D supervisor's power tends to be more referent, based on the supervisor's charisma, rather than expert or legitimate. Therefore, the requirements that are most desirable in R&D managers are good communication skills, a sense of order, the

willingness to make decisions and assume responsibility, the ability to motivate people, and strong personal integrity.

#### Summary

The study of organizations involves examining many variables. These variables include the work unit supervisor's personality type, work unit structure, work unit communication flow, and work unit effectiveness. These variables do not exist in a vacuum; they interact with each other and they interact in different ways for different type organizations. Therefore, the fact that this is a study of R&D organizations should have a noticeable effect on these four variables. The knowledge gained in studying the interrelationships of these variables will allow managers to more effectively control their organizations, rather than the organizations controlling them.

### III. Research Hypotheses

#### Introduction

In order to test for interrelationships between the four variables (work unit supervisor's personality type, work unit structure, work unit communication flow, and work unit effectiveness) in a research and development organization, aspects of each of these variables were examined against each other. This process resulted in six research hypotheses. These hypotheses did not attempt to prove causality between variables. Instead, they focused on examining the relationships between variables, and the strength of those relationships. A systems view of these hypotheses can be seen in Figure 2.

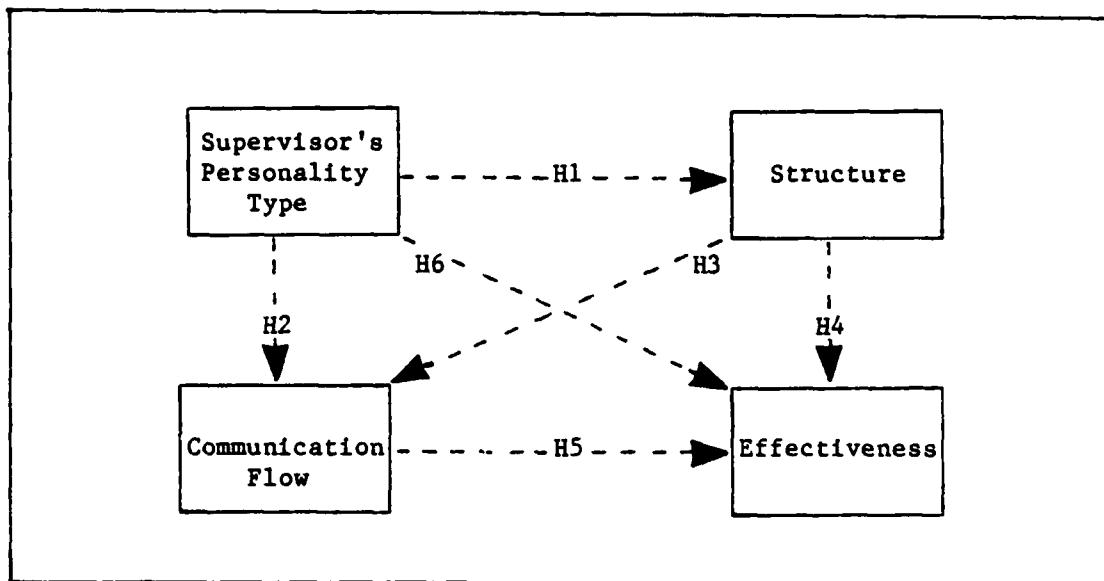


Figure 2. Systems View of Research Hypotheses

### Personality Type and Structure

ST personalities focus on facts, which are collected and verified by the senses. They make decisions about these facts based on impersonal thinking (22:158). They tend to be very practical and matter of fact, and like established ways of doing things (22:164).

NF personalities, on the other hand, focus on possibilities, such as new projects or new truths. They show personal warmth in handling these possibilities. They are enthusiastic and insightful, and excel in situations that require creativity (22:159-160).

Mechanistically structured work units are characterized by high task specialization (complexity), clear rules (formalization), and centralized decision making (14:46).

Conversely, organically structured work units are characterized by low task specialization (complexity), low formalization, and decentralized decision making. In addition, participatory decision making after consultation is emphasized and knowledge from the lower levels of the organization is highly valued (14:46).

Therefore, ST managers should prefer mechanistically structured work units, which permit decision making in an impersonal, routine manner and reduce the requirements for dealing with people, rather than facts. NF managers, however, ought to prefer organically structured work units, which encourage decision making primarily based upon interactions with people, rather than relying solely upon facts. Organically structured work units allow NF managers to use their creativity more fully because they are not limited by a highly formalized set of rules and procedures.

This results in the first research hypothesis:

H1: ST managers tend to have more mechanistically structured work units than do NF managers.

#### Personality Type and Communication Flow

ST personalities want facts. They want everything spelled out in detail (22:59). They reach conclusions in a step-by-step manner (22:164). Therefore, they require a great deal of communication in order to gather all these facts, and will probably express frustration over information that is inaccurate, nonspecific, unreliable or not readily available.

NF personalities, on the other hand, get bored with routine details (22:60). They dislike taking the time required for precision (22:164). Therefore, they will seek more aggregate information and will be less likely to express frustration with inaccurate and nonspecific information. However, they will often become frustrated when information, no matter how general, is not readily available for them to use in exploring new problems.

This leads to the following research hypotheses:

H2: In comparison to NF managers, ST managers tend to receive from members of their work units:

H2A. more specific information.

H2B. more accurate information.

#### Structure and Communication Flow

Organically structured work units have low complexity, low formalization, and are highly decentralized (14:46). They have wide spans of control, with more emphasis on consensus decision making

(6:194). In these units, there is less emphasis on upward and downward communications; instead, members communicate across all levels of the organization to obtain information and advice (31:362-363).

Mechanistically structured work units, however, are highly complex, highly formalized, and highly centralized (14:46). They feature many layers of management, narrow spans of control, unity of command (each subordinate reports to only one supervisor), and a formal hierarchy (6:191-193). These units use upward and downward communications almost exclusively due to their formal chain of command (32:300).

This suggests the following research hypothesis:

H3: Organically structured work units tend to receive a greater percentage of work-related information from other work units in the organization as compared to mechanistically structured work units.

#### Structure and Effectiveness

Research and development organizations are characterized by a more turbulent environment and a more complex technology (6:203). Therefore, they will require the flexibility and adaptability that an organic structure makes possible (31:363). An organic structure is less complex, allowing workers to do whatever tasks are required due to the unstable R&D environment. It is also less formal, which allows workers to be creative in their responses to the situation. Finally, an organic structure is less centralized, allowing more workers to be involved in the decision-making process so that the organization can rapidly respond to changes in the environment (32:300). Organic

structures also allow more horizontal communication, which will aid in decision-making (9:103).

This leads to the fourth research hypothesis:

H4: In research and development organizations, organically structured work units should achieve higher effectiveness ratings than mechanistically structured work units.

#### Communication Flow and Effectiveness

Improved communication enhances an organization's decision-making ability by reducing the uncertainty accompanying the decision (19:13). Improved communication also results in higher worker satisfaction due to the increased interaction among workers (9:103). Therefore, organizational effectiveness should improve as the organization makes better decisions and as workers become more satisfied.

This suggests the following research hypothesis:

H5: Organizational work units that promote the flow of high quality (accurate, relevant, reliable, and specific) work-related information between unit members tend to achieve higher effectiveness ratings than work units that do not promote such communication flow.

#### Personality Type and Effectiveness

NF managers focus their attention on possibilities rather than facts, and approach decision-making with personal warmth (22:6). They are the best personality type for communicating with R&D scientists, who are usually NT's or NF's (22:157). They can provide the consultation and encouragement that are required by R&D scientists, and are better equipped to give broad guidance to the work unit.

ST managers, on the other hand, are more interested in facts and usually make decisions based upon impersonal analysis (22:5). The

ST personality type would tend to try to do the R&D scientist's job for him, and not provide the support and advice that the R&D scientist requires.

This leads to the sixth research hypothesis:

H6: In research and development organizations, work units that are managed by NF personalities tend to achieve higher effectiveness ratings than work units managed by ST personalities.

#### Summary

This chapter examined the interrelationships between four variables (work unit supervisor's personality type, work unit structure, work unit communication flow, and work unit effectiveness) in a research and development organization. In order to test these interrelationships, six research hypotheses have been proposed.

Methods of data collection and analysis for testing these hypotheses will be covered in Chapter IV, Research Methodology.

#### IV. Research Methodology

##### Introduction

In order to test the research hypotheses, it was necessary to gather data from work units in research and development organizations. Included in this data were measures of four major variables: work unit supervisor's personality type, work unit structure, work unit communication flow, and work unit effectiveness. After the data had been collected and aggregated, statistical tests were performed on it to examine the interrelationships among the four variables.

##### Data Collection

The data used to test the research hypotheses was collected by Triscari in 1984 from research and development organizations in the Department of Defense (33:89). It was collected through the use of three instruments: a unit member survey, an evaluator survey, and a version of the Myers-Briggs Type Indicator questionnaire. Whenever possible, these questionnaires were personally distributed to each individual participating in the study (33:99). Although surveys were numbered to allow them to be matched with the work unit from which they came, individual anonymity was maintained (33:100).

Unit Member Survey. The unit member survey was distributed to all members of participating work units. The purpose of this survey was to obtain data on members' perceptions of the contextual variables, organizational variables, and information processing behaviors within their work units (33:74). All items in this survey use seven-point, Likert-like scales. The survey items were mostly a combination of

instruments previously used in research, but some items were tailored to the R&D setting (33:76). A copy of the unit member survey is contained in Appendix A.

Unit Structure. The purpose of the unit structure section of the questionnaire was to assess the extent to which the work unit structure was organic or mechanistic. Four dimensions of structure were measured: formalization (eight items), centralization (five items), specialization (eight items), and impersonality (two items). A mechanistic work unit was characterized as having a high degree of formalization, centralization, specialization, and impersonality (33:80-81).

Communication Flow. The work unit's communication flow was measured in terms of information processing requirements and information processing capabilities (33:77). Information requirements were examined based upon the work unit member's communications with four mutually exclusive sources: the member's immediate supervisor, other unit members, others outside the work unit but within the organization, and others outside the organization (33:82).

Information processing capabilities were measured based upon the accessibility to the information sources and the quality of the information sources (33:83). Three items in the questionnaire (reflecting availability, ease, and difficulty) were used to measure information accessibility and five items (reflecting accuracy, specificity, relevance, reliability, and quality) were used to measure information quality (33:83-84).

Evaluator Survey. The evaluator's survey was administered to upper level managers within the organization (33:99). The purpose of this survey was to provide an assessment of the effectiveness of the work units participating in the study. Managers were asked to evaluate the effectiveness of work units with which they were familiar. Each work unit was independently rated by two or three evaluators on a nine-point scale (33:87). Work unit effectiveness was measured in terms of productivity, adaptability, cooperation, and anticipation of future problems, along with the general R&D program management parameters of technical, cost, and schedule performance (33:77). A copy of the evaluator survey is contained in Appendix B.

MBTI Questionnaire. A version of the Myers-Briggs Type Indicator questionnaire was administered to all work unit supervisors in the organization. The purpose of this questionnaire was to provide information on the supervisor's psychological (or personality) type. The questionnaire administered to the supervisors was an abbreviated version in that it only contained 40 questions instead of the usual 126 questions. Based upon their answers to the questions, supervisors could be categorized according to their perceiving preference (sensing or intuition) and their judging preference (thinking or feeling). These preferences can be combined to form four combinations: sensing-thinking (ST), sensing-feeling (SF), intuitive-thinking (NT), and intuitive-feeling (NF) (22:4). A copy of the MBTI questionnaire used is contained in Appendix C.

Data Collection Sites and Subjects. Data used in this research was collected from organizations in the Air Force Systems Command

(AFSC). AFSC is responsible for all Air Force research and development activities and is organized into four major functional areas: laboratories, product divisions, test ranges and centers, and specialized divisions (33:89). The four laboratories and two product divisions from which data was collected are listed in Table I.

TABLE I  
Identification and Location of Data Collection Sites (33:90)

<u>Organization</u>	<u>Site</u>
<u>Laboratories</u>	
Rome Air Development Center	Griffiss AFB, NY
Aero Propulsion Laboratory	Wright-Patterson AFB, OH
Avionics Laboratory	Wright-Patterson AFB, OH
Flight Dynamics Laboratory	Wright-Patterson AFB, OH
<u>Product Divisions</u>	
Electronic Systems Division	Hanscom AFB, MA
Aeronautical Systems Division	Wright-Patterson AFB, OH

The Rome Air Development Center (RADC) and the Electronic Systems Division (ESD) are responsible for research and development of electronic systems and subsystems. The Aero Propulsion, Avionics, and Flight Dynamics laboratories are responsible for performing research on aircraft systems and subsystems. The Aeronautical Systems Division is responsible for the development of new aircraft and aircraft systems (33:90-91).

Within these four laboratories and two product divisions, data was collected from 80 work units: 42 laboratory (research) work units and

38 product division (development) work units. Each of these work units was formally recognized by the organization; that is, there was a formal management or supervisor position within each work unit. Work units were selected at the lowest formally recognized level in their organizations in order to ensure inter-organizational comparability (33:91). Although research work units are normally different from development work units, those surveyed in this research were considered to be homogeneous because they were all working on high-technology projects and were all organized under Air Force Systems Command.

Of the 861 surveys that were distributed, 561 usable responses were returned, for a 65.2% response rate (33:91). The sample population returning usable surveys was considered to be representative of the overall population based on an analysis of demographic statistics (33:93). Table II lists the number of work units surveyed, the mean work unit size, and the mean work unit response rate for both research work units and development work units. The lower response rate for development work units is due to the higher travel rate reported by those personnel (33:93).

TABLE II  
Summary of R&D Work Units Surveyed (33:95)

	<u>Mean Unit # Surveyed</u>	<u>Mean Unit Size</u>	<u>Response Rate</u>
Research Units	42	13.0	72.1%
Development Units	38	9.0	63.9%

Variable Measurement and Computation. Factor analysis was performed on the major variables in order to obtain the factors or dimensions associated with each variable. Work unit scores for each variable and dimension were computed to be the mean of the values of the individual unit member scores (33:100-101). Table III summarizes these variables and associated dimensions.

TABLE III  
Summary of Major Variables and Associated Dimensions (33:106-107)

<u>Variable</u>	<u>Dimension</u>	<u># of Items in Dimensional Scale</u>	<u>Cronbach Alpha</u>
Unit Structure	Centralization	4	.86
	Formalization	4	.84
	Participation in Decision Making	3	.68
Information Requirements	Supervisors	2	.84
	Unit Members	2	.78
	Organizational Members	2	.64
	External Sources	2	.75
Information Capabilities	Supervisors	8	.88
	Unit Members	8	.85
	Organizational Members	8	.80
	External Sources	8	.86

Instrument Validity. Face and content validity of the measures used in the survey instruments were demonstrated by a thorough review of the literature and through the subjective evaluation of experts in the field. Face validity of the scales was improved by use of a field pilot study. The unit structure, information processing capability, and performance scales were all developed based upon well-documented and established instruments in the field of organizational research (33:87-88).

Data Analysis

The purpose of the statistical analysis is to look for interrelationships among the four variables in order to test the research hypotheses. SPSS<sup>X</sup>, a computer-based statistical package, facilitated this analysis process.

Level of Measurement. The data collected through the questionnaires was in the form of seven or nine-point Likert-like scales. There is some disagreement over what level of measurement a Likert scale represents. Weiss (37:19) calls it ordinal scale data, Emory (7:124) calls it ordinal scale with origin, and Stone (30:38-39) refers to it as interval scale data. In this research study, Likert-scale data was treated as interval scale data. Therefore, parametric tests, such as product-moment correlation and analysis of variance, were used in the data analysis (7:125).

Data Reduction. Due to the large volume of data collected, some data reduction was necessary in order to make the data analysis process more manageable (7:386). First, the personality types of the 80 work unit supervisors were analyzed to look for strong tendencies toward one

of the four combinations: ST, SF, NT, or NF. Only the 31 supervisors showing strong tendencies, along with their work units, were used in this research. A summary of these supervisors and their personality types is listed in Table IV.

TABLE IV  
Summary of Work Unit Supervisors' Personality Types

<u>Personality Type</u>	<u># of Supervisors</u>
ST	15
SF	5
NT	6
NF	5

Within these 31 work units, work unit member data was aggregated into an overall work unit mean for each variable. Each work unit was then treated as a separate case. Therefore, 31 cases were compared in this research. In addition, major variables, such as structure, information accessibility, information quality, and overall effectiveness, were computed for each work unit (case).

Correlation Analysis. Correlation is the "statistical relationship between a set of variables, none of which have been experimentally manipulated" (17:1). More simply stated, correlation measures the extent to which a change in one variable is accompanied by a change in another variable (37:161). It should be stressed that although causality implies correlation, correlation does not imply

causality (30:32). Correlation analysis yields a correlation coefficient, which not only summarizes the strength of association between two variables, but also provides a means for comparing the strength of relationship between one pair of variables and a different pair (23:276). The parametric correlation measure most commonly used is the Pearson product-moment correlation coefficient, denoted as  $r$  (7:439). Pearson correlation analysis was used to test research hypotheses H3, H4, and H5.

The correlation coefficient,  $r$ , indicates the strength and direction of the linear relationship between variables: it is large when variables are closely related and small when there is little relationship (3:363). The correlation coefficient,  $r$ , can range in value from +1 (perfect positive correlation) to -1 (perfect negative correlation) (7:439). An even more meaningful indication of the strength of the relationship between variables is given by the coefficient of determination, designated  $r^2$ , which is computed by squaring the correlation coefficient,  $r$  (20:452).

Analysis of Variance. The technique known as analysis of variance (ANOVA) is used to determine whether or not significant differences exist among the means of several groups of observations (3:241). The object of ANOVA is to break the total variance down into its component parts so that each part : effect can be evaluated (7:432). The simplest form of ANOVA is the one-way model which is used to compare the impact of a single independent variable on the dependent variable (7:429). One-way analysis of variance was used to test research hypotheses H1, H2A, H2B, and H6.

SPSS<sup>X</sup> Batch System. The SPSS<sup>X</sup> (Statistical Package for the Social Sciences) Batch system is a comprehensive tool that can be used for managing, analyzing, and displaying data. It allows a broad range of statistical analyses and data modification tasks to be accomplished in a simple, English-like language (24:xi). SPSS<sup>X</sup> was used to aggregate the data by work unit and perform Pearson correlation and ANOVA computations on the aggregate data.

#### Summary

This chapter described the methodology that was used to test the research hypotheses. The SPSS<sup>X</sup> Batch system was used to aggregate the data within the work units and then perform statistical tests on the aggregate data to determine if there existed any significant relationships between the variables under consideration. The results of this data analysis will be covered in Chapter V, Research Results.

## V. Research Results

### Introduction

Statistical tests were performed on the data to examine the interrelationships between four major variables: work unit supervisor's personality type, work unit structure, work unit communication flow, and work unit effectiveness. A research hypothesis would be supported if the relationship between its variables was found to be significant. For the purposes of this research, a significance level of .05 was used.

### Hypothesis #1

Hypothesis #1 proposed the following relationship between the supervisor's personality type and work unit structure:

H1: ST managers tend to have more mechanistically structured work units than do NF managers.

A one-way analysis of variance did not yield a significant difference in the structure of work units managed by ST's as compared to work units managed by NF's (see Table V).

TABLE V  
ANOVA Table: Structure by Personality Type

<u>Source</u>	<u>DF</u>	<u>Sum of Squares</u>	<u>Mean Squares</u>	<u>F Ratio</u>	<u>F Prob.</u>
Between Groups	1	.0788	.0788	.2577	.6179
Within Groups	18	5.5037	.3058		
Total	19	5.5825			

Although the sample mean for structure was higher for work units managed by ST's than it was for work units managed by NF's (see Table VI), this difference was not significant. Therefore, H1 was not supported by this research.

TABLE VI  
Structure of Selected Personality Types

<u>Group</u>	<u>Count</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
ST	15	2.3380	.4413	1.6728	3.2094
NF	5	2.1930	.8332	1.1204	3.2222
Total	20	2.3018	.5420	1.1204	3.2222

Hypothesis #2

Hypothesis #2 proposed the following relationship between the supervisor's personality type and work unit communication flow:

H2: In comparison to NF managers, ST managers tend to receive from members of their work units:

H2A. more specific information.

H2B. more accurate information.

A one-way analysis of variance was used to test these hypotheses. Based on this ANOVA, there was no significant difference in the specificity of information provided to ST or NF managers by their work units (see Table VII). Although work units tended to provide slightly more specific information to ST managers than to NF managers (see Table VIII), the difference was not significant.

TABLE VII

ANOVA Table: Information Specificity from Work Unit by Personality Type

<u>Source</u>	<u>DF</u>	<u>Sum of Squares</u>	<u>Mean Squares</u>	<u>F Ratio</u>	<u>F Prob.</u>
Between Groups	1	.2428	.2428	1.0641	.3159
Within Groups	18	4.1072	.2282		
Total	19	4.3500			

TABLE VIII

Information Specificity of Selected Personality Types

<u>Group</u>	<u>Count</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
ST	15	4.0297	.4461	3.0000	4.7143
NF	5	3.7752	.5746	3.0000	4.3333
Total	20	3.9661	.4785	3.0000	4.7143

The ANOVA also yielded no significant difference in the accuracy of information provided to ST or NF managers by their work units (see Table IX). In fact, work units tended to provide somewhat more accurate information to NF managers (see Table X). Based on these results, H2A and H2B were not supported.

TABLE IX

ANOVA Table: Information Accuracy from Work Unit by Personality Type

<u>Source</u>	<u>DF</u>	<u>Sum of Squares</u>	<u>Mean Squares</u>	<u>F Ratio</u>	<u>F Prob.</u>
Between Groups	1	.1491	.1491	.6539	.4293
Within Groups	18	4.1045	.2280		
Total	19	4.2536			

TABLE X

Information Accuracy of Selected Personality Types

<u>Group</u>	<u>Count</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
ST	15	4.2492	.5242	2.6667	4.8000
NF	5	4.4486	.2535	4.0000	4.6000
Total	20	4.2990	.4732	2.6667	4.8000

Hypothesis #3

Hypothesis #3 proposed the following relationship between work unit structure and work unit communication flow:

H3: Organically structured work units tend to receive a greater percentage of work-related information from other work units in the organization as compared to mechanistically structured work units.

A correlation analysis was performed to test this hypothesis. In this case, the Pearson correlation coefficient,  $r$ , is a negative value (see Table XI), which means that there is a negative relationship between the degree to which the work unit is mechanistically structured

and the percentage of work-related information coming from other work units in the organization (denoted as PERCT3). However, the relationship is not significant ( $p < .15$ ). Therefore, H3 was not supported by the data.

TABLE XI  
Correlation Matrix: Structure by PERCT3

	<u>PERCT3</u>
<u>Structure</u>	r: -.1927 p: .149

Hypothesis #4

Hypothesis #4 proposed the following relationship between work unit structure and work unit effectiveness:

H4: In research and development organizations, organically structured work units should achieve higher effectiveness ratings than mechanistically structured work units.

A correlation analysis was performed to test this hypothesis. The analysis did not yield a significant relationship (see Table XII) between structure and overall effectiveness (denoted as UFFECT). Therefore, H4 is not supported.

TABLE XII  
Correlation Matrix: Structure by UEFFECT

<u>UEFFECT</u>	
<u>Structure</u>	r: .0217
	p: .454

Hypothesis #5

Hypothesis #5 proposed the following relationship between work unit communication flow and work unit effectiveness:

H5: Organizational work units that promote the flow of high quality (accurate, relevant, reliable, and specific) work-related information between unit members tend to achieve higher effectiveness ratings than work units that do not promote such communication flow.

A correlation analysis yielded several relationships which approach significance between the flow of high quality work-related information among unit members (denoted as INFQUAL2) and higher unit effectiveness (see Table XIII). Although the relationship between INFQUAL2 and overall unit effectiveness (UEFFECT) was not significant, the relationship between INFQUAL2 and the unit's ability to anticipate problems (denoted as E5) was significant. In addition, the relationships between INFQUAL2 and the unit producing high-quality products (E2), efficiency in resource utilization (E4), the unit meeting technical standards (E7), and the unit's ability to cope with emergencies (E9) all approach significance. Based on these results, H5 was partially supported by the research.

TABLE XIII

Correlation Matrix: INFQUAL2 by UEFFECT, E2, E4, E5, E7, and E9

	<u>UEFFECT</u>	<u>E2</u>	<u>E4</u>	<u>E5</u>	<u>E7</u>	<u>E9</u>
<u>INFQUAL2</u>	r: .2353	.2217	.2790	.3519	.2091	.2751
	p: .101	.115	.064	.026	.129	.067

#### Hypothesis #6

Hypothesis #6 proposed the following relationship between the supervisor's personality type and work unit effectiveness:

H6: In research and development organizations, work units that are managed by NF personalities tend to achieve higher effectiveness ratings than work units managed by ST personalities.

A one-way analysis of variance did not yield a significant difference in the effectiveness of work units managed by ST's as compared to work units managed by NF's (see Table XIV). Although the mean value for effectiveness for work units managed by NF's was higher than that for ST's (see Table XV), the difference was not significant. Therefore, H6 was not supported by the research.

TABLE XIV

ANOVA Table: Effectiveness by Personality Type

<u>Source</u>	<u>DF</u>	<u>Sum of Squares</u>	<u>Mean Squares</u>	<u>F Ratio</u>	<u>F Prob.</u>
Between Groups	1	78.9671	78.9671	1.2058	.2866
Within Groups	18	1178.8454	65.4914		
Total	19	1257.8125			

TABLE XV  
Effectiveness of Selected Personality Types

<u>Group</u>	<u>Count</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
ST	15	72.8111	8.5738	58.5000	86.2500
NF	5	77.4000	6.1176	68.0000	84.0000
Total	20	73.9583	8.1364	58.5000	86.2500

Summary

The results of the data analysis were varied. H1, H2A, H2B, H3, H4, and H6 were not supported by the research. H5 was only partially supported by the research. In addition, many other strong relationships at a dimensional level surfaced during the data analysis. A discussion of these relationships, the research hypotheses, and other significant findings of this research will be covered in Chapter VI, Discussion and Conclusions.

## VI. Discussion and Conclusions

### Introduction

The data analysis yielded some interesting results. Most of the hypotheses (H1, H2A, H2B, H3, H4, and H6) were not supported by the research and H5 was only partially supported. These results may be explained in part by the small sample sizes available for analysis ( $n = 31$ ).

The results of the analysis cast doubt on the validity of the model proposed in Chapter III (see Figure 3). However, several strong relationships between variables surfaced during the analysis. These new relationships may prove useful in amending and rebuilding the model.

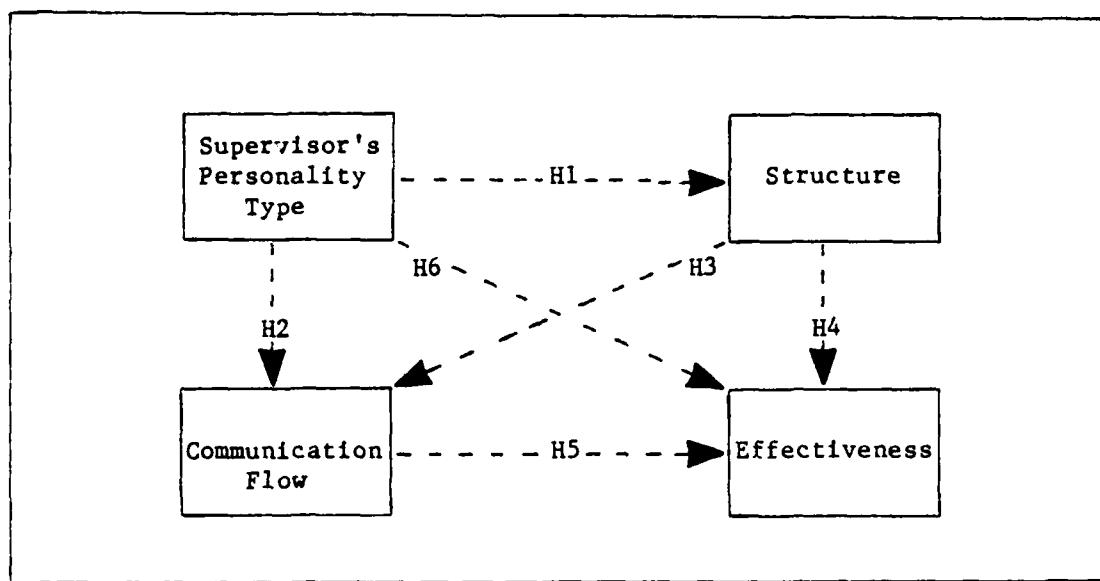


Figure 3. Hypothesized Relationships Among Variables

Personality Type and Structure

The data analysis did not support H1, which proposed that ST managers tend to have more mechanistically structured work units than do NF managers. The results of the analysis indicated that the most mechanistically structured (highest mean value in Table XVI) work units were managed by SF managers. This difference was not significant, however (see Table XVII).

TABLE XVI  
Structure of All Personality Types

<u>Group</u>	<u>Count</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
ST	15	2.3380	.4413	1.6728	3.2094
SF	5	2.4766	.2012	2.2222	2.7546
NT	6	2.0724	.4988	1.2262	2.5259
NF	5	2.1930	.8332	1.1204	3.2222
Total	31	2.2856	.4983	1.1204	3.2222

TABLE XVII  
F Probabilities: Structure by Personality Type

<u>Groups</u>	<u>F Probability</u>
ST vs NF	.6179
SF vs ST	.5114
ST vs NT	.2438
SF vs NT	.1256
SF vs NF	.4807
NF vs NT	.7724

When structure was divided into the dimensions of centralization, formalization, and participation in decision making, work units managed by SF's were significantly higher ( $F$  Probability < .05) in formalization than work units managed by NT's, and work units managed by ST's were noticeably higher ( $F$  Probability < .08) in centralization than work units managed by NT's. In addition, work units managed by sensing types were found to be somewhat higher ( $F$  Probability < .16) in centralization and formalization than work units managed by intuitive types. These results may be attributed in part to the small sample sizes available for each personality type and the limited opportunities for managers in DOD organizations to structure their work units in accordance with their personality types.

It was not surprising that work units managed by sensing types (ST's and SF's) were consistently higher in formalization and centralization than work units managed by intuitives (NT's and NF's). Sensing types like established ways of doing things, whereas intuitives dislike doing the same thing repeatedly (22:164). Therefore, H1 can be amended into H1\* as follows:

H1\*: Work units managed by sensing types (ST's and SF's) tend to show more formalization and centralization in their structure than do work units managed by intuitive types (NT's and NF's).

#### Personality Type and Communication Flow

The data analysis also did not support H2, which proposed that in comparison to NF managers, ST managers tend to receive more specific and accurate information from members of their work units. However, some strong relationships were noted between personality type and

communication flow. The strength of these relationships are shown in Table XVIII. Work units managed by ST's received significantly more relevant (RELE1), specific (SPECIFIC1), and higher quality (QUAL1) information from their immediate supervisors than did work units managed by NT's. They also received significantly more reliable (RELIA2), and somewhat more relevant (RELE2) and specific (SPECIFIC2) information from members of their work units. Work units managed by ST's also significantly exceeded work units managed by NF's in RELE1 and SPECIFIC1, and SF's were significantly higher than NT's in QUAL1.

TABLE XVIII  
F Probabilities: Communication Flow by Personality Type

<u>Groups</u>	<u>Dimensions</u>	<u>F Probability</u>
ST vs NT	RELE1	.0311
	SPECIFIC1	.0292
	QUAL1	.0160
	RELIA2	.0159
	RELE2	.1249
	SPECIFIC2	.1403
ST vs NF	RELE1	.0317
	SPECIFIC1	.0083
ST vs SF	SPECIFIC1	.0805
	SPECIFIC2	.0580
	RELIA2	.0510
SF vs NT	QUAL1	.0489

The trend here seems to be that work units managed by sensing types, particularly ST's, receive better (more specific, more relevant, more reliable, and higher in quality) information from their immediate

supervisors and members of their work units than do work units managed by intuitive types. This is understandable in that sensing types want everything spelled out to them so they can achieve a complete understanding of the situation (22:59-60). Information provided by their immediate supervisors and members of their work units will reflect the sensing types' desire for detail. However, there is little difference in the information received from other work units in the organization or from sources outside the organization, perhaps because the manager has less influence over the information being supplied by these sources. Based on these results, H2 can be changed to H2\* as follows:

H2\*: In comparison to work units managed by intuitive types, work units managed by sensing types receive from their immediate supervisors and unit members:

- H2A\*. more specific information.
- H2B\*. more relevant information.
- H2C\*. more reliable information.
- H2D\*. higher quality information.

#### Structure and Communication Flow

The data analysis did not support H3, which proposed that organically structured work units receive a greater percentage of their work-related information from other work units in the organization (PERCT3) as compared to mechanistically structured work units (see Table XIX). However, a relationship approaching significance ( $p < .07$ ) was found between work unit structure and the percentage of information coming from their immediate supervisors (PERCT1). In this case, the positive value for  $r$  reveals that PERCT1 is strongly related to

mechanistically structured work units. This fits with the common perception that mechanistically structured organizations demonstrate a higher degree of vertical communications than do organically structured organizations (15:121).

TABLE XIX  
Correlation Matrix: Structure by PERCT1, PERCT3

	<u>PERCT1</u>	<u>PERCT3</u>
	r: .2789	-.1927
<u>Structure</u>	p: .064	.149

The data analysis also yielded some significant relationships ( $p < .05$ ) between work unit structure and information accessibility (see Table XX). Organically structured work units (as identified by the negative r value) were related significantly to accessibility of information from immediate superiors (ACCESS1), members of the work unit (ACCESS2), and sources outside the work unit (ACCESS4). These relationships may be due to the higher degree of lateral and open

TABLE XX  
Correlation Matrix: Structure by Information Accessibility

	<u>ACCESS1</u>	<u>ACCESS2</u>	<u>ACCESS3</u>	<u>ACCESS4</u>
	r: -.5224	-.4096	-.1426	-.3181
<u>Structure</u>	p: .001	.011	.222	.041

communications in organically structured organizations resulting in a much greater accessibility to work-related information (15:121).

The analysis also revealed several strong relationships between the dimensions that comprise work unit structure (formalization, centralization, and participation in decision making) and the dimensions of information quality (accuracy, reliability, relevance, quality and specificity). These relationships are listed in Table XXI. Formalization (FORMAL) demonstrated a significant relationship with the quality of information received from supervisors (QUAL1) and the accuracy of information received from other work units in the organization (ACCUR3), and relationships approaching significance with the accuracy (ACCUR2) and quality (QUAL2) of information received from unit members. Centralization (CENTRAL) was related to ACCUR3 at a

TABLE XXI  
Correlations Between Structure and Information Quality

<u>Variables</u>	<u>r</u>	<u>p</u>
FORMAL by QUAL1	.3006	.050
FORMAL by QUAL2	.2037	.136
FORMAL by ACCUR2	.2370	.100
FORMAL by ACCUR3	.3503	.027
CENTRAL by ACCUR3	.2625	.077
PARTDM by RELE1	-.4376	.007
PARTDM by RELE2	-.2363	.100
PARTDM by RELIA1	-.4365	.007
PARTDM by RELIA2	-.4275	.008
PARTDM by RELIA4	-.2132	.125
PARTDM by QUAL1	-.3007	.050
PARTDM by QUAL2	-.2347	.102
PARTDM by SPECIFIC1	-.2637	.076
PARTDM by SPECIFIC2	-.3325	.034
PARTDM by SPECIFIC3	-.3079	.046

level that approached significance. The positive value for  $r$  indicates that there is a positive relationship between mechanistic structure (in terms of formalization and centralization) and information quality. This seems to indicate that clearly defined rules and procedures for job behavior and centralized decision making stimulate the flow of accurate information.

However, when another dimension of structure, participation in decision making, was analyzed against the dimensions of information quality, a different trend emerged. Participation in decision making (PARTDM) showed a significant relationship with the relevance (RELE1), reliability (RELIAL), and quality (QUAL1) of information received from supervisors, the reliability (RELIA2) and specificity (SPECIFIC2) of information received from work unit members, and the specificity (SPECIFIC3) of information received from other work units in the organization. PARTDM also was related to the specificity of information received from supervisors (SPECIFIC1), the relevance (RELE2) and quality (QUAL2) of information received from work unit members, and the reliability of information received from sources outside the organization (RELIA4) at levels approaching significance. The negative value for  $r$  indicates that there is a negative relationship between mechanistic structure (in terms of participation in decision making) and information quality. This seems to indicate that permitting members to participate in the decision making process will stimulate the flow of high quality information.

These relationships seem to be contradictory in places. However, some tendencies emerge from the results. Work units that are

mechanistically structured in terms of formalization and centralization tend to receive more accurate information, particularly from work unit members and other work units in the organization. On the other hand, work units that are organically structured tend to receive more reliable, relevant, and specific information, particularly from their immediate supervisors and work unit members. With these trends and the trend concerning information accessibility in mind, H3 can be amended as follows:

H3\*: As compared to mechanistically structured work units, organically structured work units tend to:

H3A\*. have greater access to information from all sources.

H3B\*. receive more reliable, relevant, and specific information, particularly from supervisors and unit members.

H3C\*. receive less accurate information, particularly from unit members and other units in the organization.

#### Structure and Effectiveness

The results of the data analysis did not support H4, which proposed that organically structured work units achieved higher effectiveness ratings than mechanistically structured work units. On the contrary, the analysis seemed to indicate that mechanistically structured work units achieved higher effectiveness ratings than organically structured work units (see Table XXII). For example, low levels of participation in decision making (PARTDM), as would be found in a mechanistically structured organization, were significantly related to the work unit's effectiveness in contributing to the organization's overall goals (E1). PARTDM was also related to the work

TABLE XXII  
Correlations Between Structure and Effectiveness

<u>Variables</u>	<u>r</u>	<u>p</u>
PARTDM by E1	.3132	.043
STRUCTUR by E1	.2114	.127
STRUCTUR by E8	.1954	.146
CENTRAL by E8	.2531	.085
CENTRAL by E9	.2422	.095
PARTDM by E8	.2670	.073
PARTDM by E9	.2370	.100

unit's effectiveness in adjusting to changes (E8) and coping with emergencies (E9) at levels approaching significance. High levels of centralization (CENTRAL), another characteristic of mechanistically structured organizations, were also related to E8 and E9 at levels approaching significance. STRUCTUR, which is a combination of PARTDM, CENTRAL, and FORMAL, is related to E1 and E8 at levels approaching significance. Although the results are somewhat vague, the trend seems to be that mechanistically structured work units are more effective in meeting organizational goals, adjusting to changes, and coping with emergencies. It is not surprising that mechanistically structured work units were more effective in meeting organizational goals, because they have greater job specialization and formalization. However, it is surprising that mechanistically structured work units were more effective in changing or emergency-filled environments. Burns and Stalker found that organic structures were better in such turbulent environments (18:188). This finding might be different if the sample size was larger. Nevertheless, H4 can be changed to H4\* as follows:

H4\*: Mechanistically structured work units tend to be more effective in meeting organizational goals, adjusting to changes, and coping with emergencies than are organically structured work units.

Communication Flow and Effectiveness

The data analysis partially supported H5, which proposed that work units that promote the flow of high quality information between unit members tend to achieve higher effectiveness ratings than work units that do not promote such information flow. High quality information from unit members was significantly related to effectiveness in anticipating problems, and was related to effectiveness in producing high quality products, efficiently using resources, meeting technical standards, and coping with emergencies at levels that approached significance.

The analysis revealed many other strong relationships at the dimensional level. Accuracy, one of the dimensions of information quality, was significantly related (see Table XXIII) to the unit's effectiveness in meeting organizational goals (E1), turning out high quality products (E2), efficiently using resources (E4), meeting technical objectives (E7), and coping with emergencies (E9). In addition, information accuracy was related to the unit's effectiveness in completing activities on time (E3), anticipating problems (E5), and cooperating with others in the organization (E6) at levels approaching significance. The relationships were strongest when effectiveness was compared against the accuracy of information coming from work unit members (ACCUR2), other work units in the organization (ACCUR3), and sources outside the organization (ACCUR4).

TABLE XXIII  
Correlations Between Information Accuracy and Effectiveness

<u>Variables</u>	<u>r</u>	<u>p</u>
ACCUR1 by E1	.2464	.091
ACCUR1 by E9	.2046	.135
ACCUR2 by E1	.4439	.006
ACCUR2 by E2	.3906	.015
ACCUR2 by E3	.2958	.053
ACCUR2 by E4	.3610	.023
ACCUR2 by E5	.2599	.079
ACCUR2 by E7	.4602	.005
ACCUR2 by E9	.3389	.031
ACCUR3 by E1	.4863	.003
ACCUR3 by E2	.3031	.049
ACCUR3 by E3	.2652	.075
ACCUR3 by E4	.3011	.050
ACCUR3 by E6	.2421	.095
ACCUR3 by E9	.4057	.012
ACCUR4 by E1	.2826	.062
ACCUR4 by E2	.4238	.009
ACCUR4 by E3	.2217	.115
ACCUR4 by E4	.2732	.069
ACCUR4 by E5	.2956	.053
ACCUR4 by E7	.3137	.043

Reliability, another dimension of information quality, was significantly related (see Table XXIV) to the unit's effectiveness in anticipating problems (E5), adjusting to changes (E8), and coping with emergencies (E9), and was related to effectiveness in turning out high quality products (E2) and efficiently using resources (E4) at levels approaching significance. These relationships were strongest when effectiveness was compared against the reliability of information coming from work unit members (RELIABILITY2) and other work units in the organization (RELIABILITY3).

TABLE XXIV  
Correlations Between Information Reliability and Effectiveness

<u>Variables</u>	<u>r</u>	<u>p</u>
RELIABILITY by E5	.2154	.122
RELIABILITY by E2	.1997	.141
RELIABILITY by E4	.1969	.144
RELIABILITY by E5	.3837	.017
RELIABILITY by E9	.2615	.078
RELIABILITY by E8	.3444	.029
RELIABILITY by E9	.3361	.032
RELIABILITY by E8	.2539	.084

Relevance, quality, and specificity, which are the other dimensions of information quality, were not significantly related to the work unit's effectiveness rating. However, at levels approaching significance, quality and specificity were positively related to unit effectiveness and relevance was negatively related to unit effectiveness.

The results of the data analysis indicate that information accuracy and reliability are significantly related to many of the dimensions of unit effectiveness. This agrees with the findings of O'Reilly and Roberts (26:678). However, the negative relationship between information relevance and unit effectiveness is surprising and may be due to the manner in which relevance was measured by the survey instrument. Based on the results of the analysis, H5 can be amended to H5\* as follows:

H5\*: Work units that promote the flow of accurate and reliable information, particularly from work unit members and other work units within the organization, will achieve higher effectiveness ratings than work units that do not promote such information flow.

### Personality Type and Effectiveness

The data analysis did not support H6, which proposed that in R&D organizations, work units that are managed by NF personalities will achieve higher effectiveness ratings than work units managed by ST personalities. Although the mean value for effectiveness for work units managed by NF's was higher than that for ST's, the difference was not significant.

However, when personality type was divided into the two judging preferences, thinking and feeling, some significant differences emerged (see Table XXV). Work units managed by feeling types were significantly higher (*F* Probability < .05) than units managed by thinking types in effectiveness at meeting organizational goals (E1), adjusting to changes (E8), and coping with emergencies (E9), and were somewhat higher (*F* Probability < .12) in effectiveness at cooperating with others in the organization (E6) and meeting technical objectives (E7).

These results indicate a trend that work units managed by feeling types (such as SF's and NF's) are more effective than work units

TABLE XXV  
*F* Probabilities: Effectiveness by Personality Type

<u>Groups</u>	<u>Dimensions</u>	<u>F Probability</u>
T vs F	E1	.0227
	E6	.0598
	E7	.1178
	E8	.0157
	E9	.0477

managed by thinking types (such as ST's and NT's). This may be due to the ability of feeling types to sympathetically deal with people, which would be helpful in relating to scientists in an R&D organization (22:163). Based on these results, H6 can be changed to H6\* as follows:

H6\*: In research and development organizations, work units that are managed by feeling types tend to achieve higher effectiveness ratings than work units managed by thinking types.

#### Amended Model

Based on the results of the data analysis, the model proposed in Chapter III can be changed (see Figure 4). This new model more accurately depicts the interrelationships among variables in R&D organizations in Air Force Systems Command.

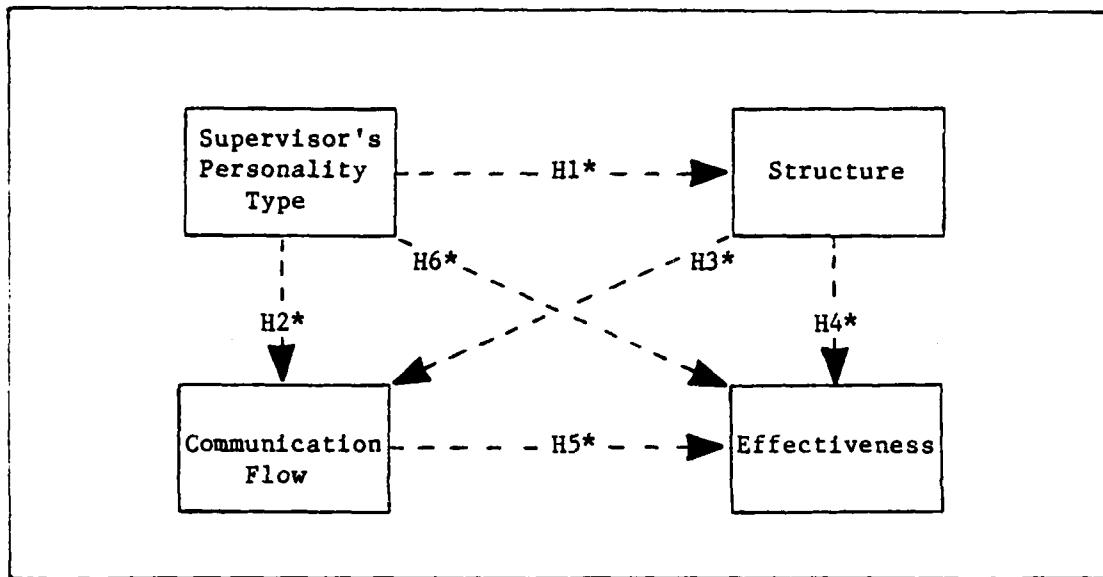


Figure 4. Amended Model of Relationships Among Variables

### Limitations of the Research

The results of this research may not be a completely accurate reflection of reality because of several limitations imposed on the research. First and foremost is the small sample sizes available for analysis. By limiting the research to the 31 work units whose managers exhibited strong tendencies toward one of the personality type combinations (ST, SF, NT, or NF), the data for the other 49 work units surveyed ended up being discarded. When these personality type combinations were compared against each other, there were as few as five work units representing a combination. This may have been one of the primary reasons for the weak or unexpected relationships discovered by this research.

Another shortcoming of this research may be that research and development organizations were considered to be homogeneous and therefore lumped together for the purposes of this study. This may not be a valid assumption due to the differences in the nature of the work performed in research organizations as compared to development organizations. Again, this may have resulted in the emergence of weak or unexpected relationships.

Finally, due to time constraints, all of the dimensions of the variables were not analyzed against each other. This may have prevented any stronger dimensional-level relationships from emerging from the weaker variable-level relationships. All of these limitations should be addressed and corrected if possible in future replications of this study.

### Recommendations

Based on the results of this research, several recommendations can be made for improving R&D organizations in Air Force Systems Command. First, H1\* indicates that sensing type managers tend to have more mechanistically (in terms of formalization and centralization) structured work units than intuitive type managers. Therefore, managers' personality types might be taken into consideration when they are assigned to an organization. For example, sensing types may be more comfortable in organizations whose size, technology, or environment would be favorably disposed towards a mechanistic structure, or in organizations that are already mechanistically structured.

H2\* identifies the importance of personality type in promoting communication flow in an R&D organization. H2\* proposes that work units managed by sensing types received more specific, relevant, reliable, and higher quality information from their immediate supervisors and work unit members than do work units managed by intuitive types. Again, managers' personality types might be considered when making assignments, with sensing types being placed in situations where high quality information flow, particularly from the supervisor or unit members, is critical. For work units that are having communication breakdowns, a sensing type manager could be chosen to facilitate information flow.

In deciding what type of organizational structure to implement, H3\* provides some input on structure's relationship with communication flow. H3\* proposes that organically structured work units have greater

access to information and tend to receive more reliable, relevant, and specific information, particularly from supervisors and unit members, than mechanistically structured work units. If the organization's technology or environment make communication flow a critical factor, then an organic structure would best promote that flow. This would seem to apply especially to research organizations, which are highly dependent on current information from sources internal and external to the organization.

H4\* proposes that mechanistically structured work units are more effective than organically structured units in meeting organizational goals, adjusting to changes, and coping with emergencies. This seems to contradict H3\*, which proposes that high accessibility to information, especially when that information is reliable, relevant, and specific, should improve effectiveness, particularly in dealing with a changing environment (as characterized by changes and emergencies). However, for a more stable environment and less complex technology, a mechanistic structure might be best. This may be applicable to certain low-technology development organizations.

H5\* proposes that the flow of accurate and reliable information will increase effectiveness. H3\* proposes that organically structured work units received more reliable but less accurate information than mechanistically structured work units. When H3\* and H5\* are combined, the contradiction present in H4\* grows. This contradiction is a ripe area for future research, and to this end a separation of the work units into research and development and a restoration of the sample size to 80 work units may both prove useful. Until then, however, the

flow of accurate and reliable information should be encouraged to foster unit effectiveness.

In attempting to select a manager to maintain or improve a work unit's effectiveness, H6\* provides some guidance. H6\* proposes that work units managed by feeling types tend to be more effective than work units managed by thinking types. As with H1\* and H2\*, this may provide some input on the best personality type for a particular job. However, there arises the question of whether the work unit managed by a feeling type is truly more effective, or is the higher effectiveness rating simply a result of the feeling type's ability to get along with people. This research could not answer that question.

The study of organizations is an iterative process. This research has uncovered some important relationships between variables present in R&D organizations. However, this research has raised as many questions as it has answered. Future researchers can attempt to answer these questions by addressing the limitations mentioned in this chapter. If implemented properly, insights gleaned by this and future studies can have a positive and lasting effect on research and development organizations in Air Force Systems Command.

Appendix A: Unit Member Survey

RENSSELAER POLYTECHNIC INSTITUTE

SCHOOL OF MANAGEMENT

SURVEY OF ORGANIZATIONAL DESIGN & COMMUNICATION

Thank you for taking time to complete this survey. When responding to the items in it, please keep the following in mind:

ALL RESPONSES ARE ANONYMOUS. Please do not identify yourself. All information will be kept STRICTLY CONFIDENTIAL.

THERE ARE NO "RIGHT" OR "WRONG" ANSWERS. Try to answer the items as you really see things. Work quickly but accurately -- your first impression about an item is usually the "best" one.

PLEASE ANSWER ALL ITEMS, IT IS EXTREMELY IMPORTANT THAT YOU ANSWER ALL ITEMS in this questionnaire. You may want to scan a section of items before answering the first of them.

In this survey, the office or group to which you are part will be referred to as a UNIT. The term UNIT is intended to mean that section of the Electronic Systems Division (ESD) for which your immediate supervisor has responsibility.

For many of the items in this survey you will be given rating scales to use to record your response. Please place the number best describing your reaction to an item in front of that item, in the space provided. The survey is 18 pages long. Completion of this questionnaire should take no longer than 35 minutes.

Thank you for your cooperation.

USAF SCN 84-17

0 Disagree Strongly	1 Disagree Slightly	2 Disagree	3 Neutral	4 Agree Slightly	5 Agree	6 Agree Strongly
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#### NATURE OF THE WORK

Using the above scale, to what extent do you agree or disagree with the following statements about the work done in your unit:

- \_\_\_\_\_ 1. The work is routine.
- \_\_\_\_\_ 2. There is a clearly known way to do the major types of work normally encountered.
- \_\_\_\_\_ 3. People in this unit do about the same job in the same way most of the time.
- \_\_\_\_\_ 4. There is an understandable sequence of steps that can be followed in doing the work.
- \_\_\_\_\_ 5. The tasks performed in doing the work differ greatly from day-to-day.
- \_\_\_\_\_ 6. It is difficult to specify a sequence of steps that can be followed in carrying out the work.
- \_\_\_\_\_ 7. Basically, unit members perform repetitive activities in doing their jobs.
- \_\_\_\_\_ 8. There is a clearly defined body of knowledge of subject matter which can guide unit members in doing the work.
- \_\_\_\_\_ 9. To a large extent, we can actually rely on established procedures and practices to do the work.
- \_\_\_\_\_ 10. There is much variety to the duties performed, that is, the work requires many different tasks and skills.

R&D programs/projects often have performance objectives established in three major areas: Technical, Cost, and Schedule. In attempts to obtain these objectives, a unit must attend to certain tasks or problems associated with each particular area. Consider the activities performed in your unit to achieve its Technical, Cost and Schedule performance objectives.

In general, to what extent do you agree or disagree that the following are UNEXPECTED or NOVEL in your unit:

- \_\_\_\_\_ 11. ...the TECHNICAL tasks or problems encountered.
- \_\_\_\_\_ 12. ...the COST/BUDGETARY tasks or problems encountered.
- \_\_\_\_\_ 13. ...the SCHEDULING related tasks or problems encountered.

0	1	2	3	4	5	6
Disagree Strongly	Disagree Slightly	Disagree	Neutral	Agree Slightly	Agree	Agree Strongly

To what extent do you agree or disagree that the following can NOT be solved using a "straight-forward" method (that is, a CREATIVE approach is often required).

- 14. ...the TECHNICAL tasks or problems encountered.
- 15. ...the COST/BUDGETARY tasks or problems encountered.
- 16. ...the SCHEDULING related tasks or problems encountered.

#### NATURE OF THE ENVIRONMENT

R&D Organizational units must work within a set of demands and pressures resulting from factors or forces both within and outside the ESD Product Division. These demands may come from individuals, groups and other organizations.

Thinking of the environment outside your unit but WITHIN ESD, please indicate the extent that you agree or disagree with the following statements.

- 17. There are frequent changes in the technical, economic, organizational, or political conditions within ESD which directly affect your unit's work.
- 18. These changes can usually be predicted or anticipated.
- 19. The environment that your unit must contend with is diverse, that is, made up of many different individuals and groups within ESD.
- 20. People can often point to prevailing ideas in their profession about the best methods or techniques to be used in their jobs. There are frequent changes in such ideas within ESD regarding your work.
- 21. You know what to expect in your work-related dealings with people outside your unit but within ESD.
- 22. Your unit is able to control or influence those factors within ESD that affect its work.
- 23. There are many different individuals or groups within ESD that affect or influence the work within your unit.

0 Disagree Strongly	1 Disagree Slightly	2 Disagree Slightly	3 Neutral	4 Agree Slightly	5 Agree	6 Agree Strongly
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Thinking of the environment OUTSIDE BOTH your unit and ESD, please indicate the extent that you agree or disagree with the following statements.

- \_\_\_\_\_ 24. There are frequent changes in the technical, economic, organizational, or political conditions outside ESD which directly affect your unit's work.
- \_\_\_\_\_ 25. These changes can often be predicted or anticipated.
- \_\_\_\_\_ 26. The environment outside of ESD that your unit must deal with is diverse, that is, made up of many different individuals, groups and organizations.
- \_\_\_\_\_ 27. People can often point to prevailing ideas in their profession about the best methods or techniques to be used in their jobs. There are frequent changes in such ideas outside of ESD regarding your work.
- \_\_\_\_\_ 28. You know what to expect in your work-related dealings with people outside of ESD.
- \_\_\_\_\_ 29. Your unit is able to control or influence those factors outside of ESD that affect its work.
- \_\_\_\_\_ 30. There are many different individuals or groups outside of ESD that affect or influence the work within your unit.

#### UNIT STRUCTURE

Using the same scale, to what extent do you agree or disagree with the following statements:

- \_\_\_\_\_ 31. This unit serves only a select clientele (i.e., customer or user) either inside or outside ESD.
- \_\_\_\_\_ 32. The personnel employed in this unit are very highly educated and trained.
- \_\_\_\_\_ 33. Usually, written rules, written policies, and written procedures are relied on to perform the day-to-day work of this unit.
- \_\_\_\_\_ 34. We always get orders or direction for our jobs from our superior.

0 Disagree Strongly	1 Disagree	2 Disagree Slightly	3 Neutral	4 Agree Slightly	5 Agree	6 Agree Strongly
---------------------------	---------------	---------------------------	--------------	------------------------	------------	------------------------

- \_\_\_\_\_ 35. The work processes and methods used are unique to this unit.
- \_\_\_\_\_ 36. Several individuals have a say in making decisions in this unit.
- \_\_\_\_\_ 37. It is always necessary to go through official channels when doing work or making decisions in this unit.
- \_\_\_\_\_ 38. For most situations, the rules and procedures are developed as the work progresses.
- \_\_\_\_\_ 39. If we feel we have the right approach to carrying out our job when dealing with a particular problem, we can usually go ahead without checking with our superior.
- \_\_\_\_\_ 40. In this unit, each person has their own responsibilities and duties that they alone are expected to perform.
- \_\_\_\_\_ 41. There is a sharing of influence within the unit in making decisions.
- \_\_\_\_\_ 42. There are written rules and procedures for handling most of the problems which may arise in this unit.
- \_\_\_\_\_ 43. People in this unit do NOT have clearly defined jobs.
- \_\_\_\_\_ 44. For the most part, we are not likely to openly express our feelings about our jobs.
- \_\_\_\_\_ 45. The same written rules and procedures are followed in doing most of the work done in this unit.
- \_\_\_\_\_ 46. To make decisions in this unit, it is necessary to have written or recorded information prepared as the rules specify.
- \_\_\_\_\_ 47. Our work requires each of us to perform many kinds of activities.
- \_\_\_\_\_ 48. We need to check with our superior before we do almost anything.
- \_\_\_\_\_ 49. Decisions are made at the "top" in this unit.

0	1	2	3	4	5	6
Disagree Strongly	Disagree Slightly	Disagree	Neutral	Agree Slightly	Agree	Agree Strongly

- \_\_\_\_ 50. People are encouraged to speak their mind on the job even if it means disagreeing with our superior.
- \_\_\_\_ 51. People in this unit always have the same areas of responsibility.
- \_\_\_\_ 52. This unit relies on written memos, reports, and forms to pass information back and forth within the unit to get the work done.

0	1	2	3	4	5	6
Never	Rarely	Once in a While	About Half the Time	Often	Almost Always	Always

#### INTER-UNIT DEPENDENCE

Please respond to the following statements using the above scale.

How often do you feel that YOUR work unit has to depend on people in other ESD units in order to get your work done in terms of the following items:

- \_\_\_\_ 53. ...maintaining minimum QUALITY standards.
- \_\_\_\_ 54. ...keeping your work on SCHEDULE.
- \_\_\_\_ 55. ...meeting TECHNICAL performance specifications.
- \_\_\_\_ 56. ...staying within BUDGET or COST limitations.

To what extent do you feel that OTHER units within ESD have to depend on your unit to get their work done in terms of the following items (even if you are not sure, please indicate what you think is the case).

- \_\_\_\_ 57. ...maintaining their minimum QUALITY standards.
- \_\_\_\_ 58. ...keeping their work on SCHEDULE.
- \_\_\_\_ 59. ...meeting their TECHNICAL performance specifications.
- \_\_\_\_ 60. ...staying within their BUDGET or COST limitations.

0 Never	1 Rarely	2 Once in a While	3 About Half the Time	4 Often	5 Almost Always	6 Always
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#### INTER-UNIT COORDINATION

The following 5 questions concern the methods that specify how units within ESD are to work together to achieve their objectives.

Using the above scale, to what extent do you feel the following methods are used to achieve COORDINATION between your unit and other units in ESD:

- \_\_\_\_\_ 61. How frequently are there written rules or procedures used which specify how ESD units are to work together (for example, regulations or policy statements)?
- \_\_\_\_\_ 62. How frequently are written plans or schedules developed jointly by the units involved to coordinate their efforts?
- \_\_\_\_\_ 63. How frequently are individuals assigned to act as a liaison or "point of contact" between two units as part of his or her duties?
- \_\_\_\_\_ 64. How frequently are temporary teams or committees (such as, ad hoc groups or task forces), composed of members from the units involved, used to coordinate work?
- \_\_\_\_\_ 65. How frequently are "permanent" teams or organizations established within ESD, composed of multiple units working together on some common effort (such as, the project or matrix organization)?

P L E A S E

C O N T I N U E

T O   N E X T   P A G E

0 Never	1 Rarely	2 Once in a While	3 About Half the Time	4 Often	5 Almost Always	6 Always
------------	-------------	-------------------------	-----------------------------	------------	-----------------------	-------------

### COMMUNICATION SURVEY

The following questions are concerned with the WORK-RELATED communications you have with individuals within and outside your unit. These communications or contacts may occur directly in person, or indirectly, such as by telephone or in writing. Using the scale above, please respond to the following items by placing the appropriate number in the space provided.

Sometimes information may exist which we know about which would be helpful in performing our job, but is NOT READILY AVAILABLE to us because of the time, expense, or difficulty in obtaining it. In general, how frequently do you find this to be the case with the information YOU NEED FROM:

- 66. ...your immediate superior?
- 67. ...members of your unit?
- 68. ...others outside your unit but within ESD?
- 69. ...others outside of ESD?

To obtain the information required to do your job, how frequently is it IMPORTANT for you to have an open (effective) communication channel with each of the following sources:

- 70. ...your immediate superior?
- 71. ...members of your unit?
- 72. ...others outside your unit but within ESD?
- 73. ...others outside of ESD?

With some of the information you receive it may be necessary to go back and check on it's ACCURACY. How frequently is this the case with information you receive from each of the following sources:

- 74. ...your immediate superior?
- 75. ...members of your unit?
- 76. ...others outside your unit but within ESD?
- 77. ...others outside of ESD?

How frequently is it easy for you to get information from each of the following sources:

- 78. ...your immediate superior?
- 79. ...members of your unit?
- 80. ...others outside your unit but within ESD?
- 81. ...others outside of ESD?

0 Never	1 Rarely	2 Once in a While	3 About Half the Time	4 Often	5 Almost Always	6 Always
------------	-------------	-------------------------	-----------------------------	------------	-----------------------	-------------

How frequently do the following sources have information you need or would find useful in performing your job:

- 82. ...your immediate superior?
- 83. ...members of your unit?
- 84. ...others outside your unit but within ESD?
- 85. ...others outside of ESD?

At times we must gather a lot of information, some not directly relevant, in order to do our job properly. Other times we need only a small amount because the information is very specific and exactly what we require. In general, how frequently is the information you receive sufficiently SPECIFIC from each of the following sources:

- 86. ...your immediate superior?
- 87. ...members of your unit?
- 88. ...others outside your unit but within ESD?
- 89. ...others outside of ESD.

How frequently do you find that you are NOT receiving an adequate amount of information to do your job from each of the following sources:

- 90. ...your immediate superior?
- 91. ...members of your unit?
- 92. ...others outside your unit but within ESD?
- 93. ...others outside of ESD?

How frequently do you find it DIFFICULT to get information from each of the following sources:

- 94. ...your immediate superior?
- 95. ...members of your unit?
- 96. ...others outside your unit but within ESD?
- 97. ...others outside of ESD?

At times we may be unsure whether to believe in the information we receive from a particular source because it may be UNRELIABLE. How frequently is this the case for the information you obtain from each of the following:

- 98. ...your immediate superior?
- 99. ...members of your unit?
- 100. ...others outside your unit but within ESD?
- 101. ...others outside of ESD?

0 Never	1 Rarely	2 Once in a While	3 About Half the Time	4 Often	5 Almost Always	6 Always
------------	-------------	-------------------------	-----------------------------	------------	-----------------------	-------------

Sometimes the information we obtain may get right to the heart of the problem we are facing. Other times the information may be too general for our particular needs. How frequently do you receive RELEVANT information from each of the following sources:

- 102. ...your immediate superior?
- 103. ...members of your unit?
- 104. ...others outside your unit but within ESD?
- 105. ...others outside of ESD?

How frequently is the information you receive from each of the following sources of sufficient QUALITY to be useful in doing your work (such as in problem-solving or decision-making):

- 106. ...your immediate superior?
- 107. ...members of your unit?
- 108. ...others outside your unit but within ESD?
- 109. ...others outside of ESD?

How frequently do you seem to receive MORE information than you can effectively use from each of the following sources:

- 110. ...your immediate superior?
  - 111. ...members of your unit?
  - 112. ...others outside your unit but within ESD?
  - 113. ...others outside of ESD?
- 

Considering the work-related communications you have with people whom you come in contact, what percentage of your communication is with each of the following: (note that this item is asking for your estimate -- do NOT use the above scale for this item)

- 114. ...your immediate superior?
- 115. ...members of your unit?
- 116. ...others outside your unit but within ESD?
- 117. ...others outside of ESD?

100% TOTAL

0	1	2	3	4	5	6
Less						
Than	Once	2-3	Once	2-4	Once	Several
Once a	a	Times	a	Times	a	Times a
Month	Month	a Month	Week	a Week	Day	Day

The following items refer to the frequency that you seek or provide Technical, Cost or Scheduling information. Please answer these items using the scale at the top of the page.

How frequently do you SEEK information from each of the following...

a. concerning TECHNICAL matters:

- 118. ...your immediate superior?
- 119. ...members of your unit?
- 120. ...others outside your unit but within ESD?
- 121. ...others outside of ESD?

b. concerning COST/BUDGETARY matters:

- 122. ...your immediate superior?
- 123. ...members of your unit?
- 124. ...others outside your unit but within ESD?
- 125. ...others outside of ESD?

c. concerning work SCHEDULING matters:

- 126. ...your immediate superior?
- 127. ...members of your unit?
- 128. ...others outside your unit but within ESD?
- 129. ...others outside of ESD?

How frequently do you PROVIDE information to each of the following...

a. concerning TECHNICAL matters:

- 130. ...your immediate superior?
- 131. ...members of your unit?
- 132. ...others outside your unit but within ESD?
- 133. ...others outside of ESD?

b. concerning COST/BUDGETARY matters:

- 134. ...your immediate superior?
- 135. ...members of your unit?
- 136. ...others outside your unit but within ESD?
- 137. ...others outside of ESD?

c. concerning work SCHEDULING matters:

- 138. ...your immediate superior?
- 139. ...members of your unit?
- 140. ...others outside your unit but within ESD?
- 141. ...others outside of ESD?

## BACKGROUND

- \_\_\_\_ 142. What is your sex?      1. Male      2. Female
- \_\_\_\_ 143. What is your age?
- \_\_\_\_ 144. What is your grade/rank?
- |            |                   |                 |
|------------|-------------------|-----------------|
| 1. GS-5/6  | 7. GS-14          | 13. O-2         |
| 2. GS-7/8  | 8. GS-15 or above | 14. O-3         |
| 3. GS-9/10 | 9. E-3/E-4        | 15. O-4         |
| 4. GS-11   | 10. E-6/E-7       | 16. O-5         |
| 5. GS-12   | 11. E-8           | 17. O-6         |
| 6. GS-13   | 12. O-1           | 18. O-7 & above |
- \_\_\_\_ 145. How long have you been in your current rank/grade?
- \_\_\_\_ 146. How many years have you been with ESD?
- \_\_\_\_ 147. How many years have you worked in this unit?
- \_\_\_\_ 148. What was the last educational program you completed or degree you received?
1. High School
  2. Associate (2 year) degree
  3. Bachelor degree
  4. Masters degree
  5. PhD.
  6. Post Doctoral
  7. Other (specify \_\_\_\_\_)
- \_\_\_\_ 149. In what field was your last degree?
0. Not Applicable
  1. Aero. Engineering
  2. Chem. Engineering
  3. Computer Eng.
  4. Electr. Eng.
  5. Indust. Eng.
  6. Mech. Eng.
  7. Mathematics
  8. Biology
  9. Chemistry
  10. Physics
  11. Computer Science
  12. Materials Eng.
  13. Other (specify \_\_\_\_\_)
- \_\_\_\_ 150. Which term BEST describes your current position in the organization? (please select one)
1. Project Manager/Section Chief
  2. Group Leader
  3. Senior Engineer/Scientist
  4. Engineer/Scientist
  5. Senior Technician
  6. Technician
  6. Other (specify \_\_\_\_\_)

- \_\_\_\_\_ 151. In which phase of the Acquisition Process is MOST of the work your unit performs?  
(please select only one)
1. Conceptual
  2. Validation
  3. Full Scale Development
  4. Production
  5. Other (specify \_\_\_\_\_)

- \_\_\_\_\_ 152. Is the majority of your unit's work CLASSIFIED?
1. Yes
  2. No

- \_\_\_\_\_ 153. Approximately what percentage of the technical work, for which your unit is responsible, is contracted or performed outside the unit?  
(please select only one)

1. less than 25%
2. 25 - 49%
3. 50 - 75%
4. more than 75%

- \_\_\_\_\_ 154. How many different projects or contracts are you currently involved with?  
(please write in the number)

- \_\_\_\_\_ 155. For an average MONTH, how many days are you TDY?  
(select one)
1. less than 2 days
  2. 2-5 days
  3. 6-10 days
  4. 11-15 days
  5. more than 15 days

P L E A S E

C O N T I N U E

T O   N E X T   P A G E

0	1	2	3	4	5	6
Never	Rarely	Once in a While	About Half the Time	Often	Almost Always	Always

Please use the above scale to respond to the following items:

How often are you involved in the:

- 156. ...TECHNICAL aspects of your unit's work?
- 157. ...COST or BUDGETARY aspects of your unit's work?
- 158. ...SCHEDULING aspects of your units work?

To what extent are you WILLING to work overtime, without being required, to obtain the:

- 159. ...TECHNICAL objectives of your unit's work?
- 160. ...COST or BUDGETARY objectives of your unit's work?
- 161. ...SCHEDULING objectives of your unit's work?

If you had your own way, to what extent would you get involved with the:

- 162. ...TECHNICAL matters of your unit's work?
  - 163. ...ADMINISTRATIVE matters of your unit's work?
- 

- 164. To what extent do the largely Technical jobs offer the same promotion opportunities as the Administrative or Management jobs?
- 165. How frequently are you able to influence or control the degree to which formal or written procedures must be followed by people in your unit?
- 166. How frequently are you able to delegate decision-making to your subordinates in your unit?
- 167. How frequently are you able to allow people in your unit to share in different work-related responsibilities?
- 168. How frequently are you able to influence the way your unit coordinates it's work with other organizational units?

For the work presently being performed in your unit, which ONE of the following two statements do you feel is more critical or important to accomplish? (please select either 1 or 2)

- \_\_\_\_ 169. (pick either 1 or 2)  
1. meeting or exceeding Technical/Performance objectives  
2. staying at or below the overall Budget/Cost constraints
- \_\_\_\_ 170. (pick either 1 or 2)  
1. completing all work activities and milestones before or on scheduled target dates  
2. staying at or below the overall Budget/Cost constraints
- \_\_\_\_ 171. (pick either 1 or 2)  
1. completing all work activities and milestones before or on scheduled target dates  
2. meeting or exceeding Technical/Performance objectives

-----  
\_\_\_\_ 172. How many professional people do you supervise?

\_\_\_\_ 173. What range does your annual budget fall in?

1. under \$ 100,000
2. under \$ 1,000,000
3. between 1 and 10 million dollars
4. between 10 and 100 million dollars
5. over 100 million dollars

**Appendix B: Evaluator Survey**

**UNIT EFFECTIVENESS QUESTIONNAIRE**

This questionnaire is being used in support of research being sponsored by the Air Force Institute of Technology and Rensselaer Polytechnic Institute. You are being asked to complete this questionnaire for the unit identified on the following page. All responses to this questionnaire will remain STRICTLY CONFIDENTIAL and in no circumstance will you or an individual unit(s) be identified in the research report. By insuring anonymity for you as well as for your organization, the investigators are attempting to provide a means for you to respond with your true feelings.

Please complete this questionnaire for those units which you are familiar. It is extremely important that you answer all items in order for the questionnaire to be included in the analysis.

Your responses to this questionnaire are an ESSENTIAL part of this research study. Thank you for your participation.

Please select the phase that best describes your position in the organization (check one):

- 1. Technical Director
- 2. Associate Technical Director
- 3. Department Head
- 4. Associate Department Head
- 5. Other (specify \_\_\_\_\_)

**UNIT/GROUP**

---

Please assess the following characteristics concerned with the "technology" or "systems" development efforts currently being undertaken by the above unit. For each of the six items, please indicate your response by writing in the NUMBER you feel best describes that particular characteristic for the unit. To facilitate this process, each item has descriptions ranging from "poor" to "superior" that serve as benchmarks for you to consider in your evaluation.

(Please note: Substitute DoD for AF)

CRITERION CATEGORY	POOR (0-1)	MARGINAL (2-3)	CORID (4-5)	EXCELLENT (6-7)	SUPERIOR (8-9)
UNIQUENESS 1.	Similar efforts widely distributed in private sector	Similar efforts scattered among a few organizations in private sector	Work in federal government only no interest and/or capability in private sector	Problem unique to DoD; AF has major interest and commitment to its solution	Problem unique to AF; only AF is working on it
PRIORITY 2.	Work is unrelated to any other AF program	Peripherally related to another AF program	Bears direct relationship to other AF programs but is not pacing	On critical path of major AF program	On critical path to development of new war-fighting capability
PAY-OFF/ ROI 3.	No foreseeable pay-off for AF systems	Could have minor effect on efficiency or nature of AF operations	Could have significant effect on efficiency and/or nature of AF operations	Could change way AF conducts its battles and/or operations	Could change way AF would fight a war
USER REQUIREMENT 4.	Unrelated to any present or perceived future user requirement	Possibly of interest to user at some point in future	Weakly coupled to user requirements	Strongly coupled to user requirements	Directly coupled to major user requirements
PEER GROUP COMPARISON 5.	Poor initiation of work which is being pursued elsewhere with much better effect	Quality of work is equivalent to that being done elsewhere	Work is better than that of all but a very few organizations	State-of-the-art work of excellent quality	Explores the frontiers of science and/or technology
PREPARATION FOR FUTURE 6.	Sacrificing technology base in order to meet immediate goals	Pursuing immediate goals with no concern for furthering technology base	Limited effort to expand technology base in scattered parts of program	Major efforts to expand technology base at many critical places in program	Pursuing major new technology or scientific discipline

0	1	2	3	4	5	6	7	8	9
Disagree					Neutral				
Strongly					Agree				
					Strongly				

#### UNIT EFFECTIVENESS

Please use the above scale to respond to each of the following items, placing the appropriate number in the space provided.

To what extent do you agree or disagree with the following statements about this unit.

- \_\_\_\_ 7. Generally, the efforts made by people in this unit contribute to the overall goals of the organization.
- \_\_\_\_ 8. The people in this unit turn out high quality products or services.
- \_\_\_\_ 9. In the last 12 months, this unit has been able to complete, on time, its planned milestones and activities.
- \_\_\_\_ 10. The people in this unit do NOT seem to get maximum output from the resources (money, time, and equipment) they have available. That is, they work inefficiently.
- \_\_\_\_ 11. The people in this unit anticipate problems that may come up in the future and prevent them from occurring or minimize their effects.
- \_\_\_\_ 12. For the most part, people are cooperative with and helpful to other people in the laboratory whom, through their work, they come in contact.
- \_\_\_\_ 13. The work performed by this unit meets or exceeds the technical objectives or standards set for it.
- \_\_\_\_ 14. When changes are made in the routines or procedures, people in this unit accept and adjust to these changes.
- \_\_\_\_ 15. When emergencies arise, such as a schedule being moved up, overloads are often caused for many people. This unit copes with these emergencies more readily and successfully than other units.
- \_\_\_\_ 16. Over the past year, this unit has been able to meet its budget limitations or cost constraints.

**Appendix C: Version of MBTI Questionnaire**

**Final Section for Group/Team Leaders and Supervisors**

**DIRECTIONS**

Read each of the following questions carefully and mark your answer in the space provided. There are NO right or wrong answers to these questions. Do not think too long about any question. If you cannot decide on a question, skip it. Please work through until you have answered all the questions you can. This section should take no longer than seven or eight minutes to complete.

- \_\_\_\_\_ 1. Are you more

  - (a) realistic than speculative
  - (b) speculative than realistic
- \_\_\_\_\_ 2. Is it worse to

  - (a) have your "head in the clouds"
  - (b) be "in a rut"
- \_\_\_\_\_ 3. Are you more impressed by

  - (a) principles
  - (b) emotions
- \_\_\_\_\_ 4. Are you more drawn toward the

  - (a) touching
  - (b) convincing
- \_\_\_\_\_ 5. Are you more attracted to

  - (a) imaginative people
  - (b) sensible people
- \_\_\_\_\_ 6. In judging others are you more swayed by

  - (a) laws than circumstances
  - (b) circumstances than laws
- \_\_\_\_\_ 7. Are you more interested in

  - (a) what is actual
  - (b) what is possible
- \_\_\_\_\_ 8. In doing ordinary things are you more likely to

  - (a) do it your way
  - (b) do it the usual way



- \_\_\_\_ 21. Are you more frequently  
(a) a practical sort of person  
(b) a fanciful sort of person
- \_\_\_\_ 22. Which is more satisfying  
(a) to discuss an issue thoroughly  
(b) to arrive at agreement on an issue
- \_\_\_\_ 23. Are you more likely to  
(a) see how others see                   (b) see how others are useful
- \_\_\_\_ 24. Do you go more by  
(a) facts                                 (b) principles
- \_\_\_\_ 25. Which rules you more  
(a) your head                             (b) your heart
- \_\_\_\_ 26. Are you more interested in  
(a) production and distribution  
(b) design and research
- \_\_\_\_ 27. Which is more of a compliment  
(a) "There is a very logical person."  
(b) "There is a very sentimental person."
- \_\_\_\_ 28. Do you value in yourself more that you are  
(a) devoted                                 (b) unwavering
- \_\_\_\_ 29. Are you more likely to trust your  
(a) hunch                                     (b) experience
- \_\_\_\_ 30. Do you feel  
(a) more practical than ingenious  
(b) more ingenious than practical
- \_\_\_\_ 31. Which person is more to be complimented: one of  
(a) clear reason                             (b) strong feeling

T H A N K

YOU

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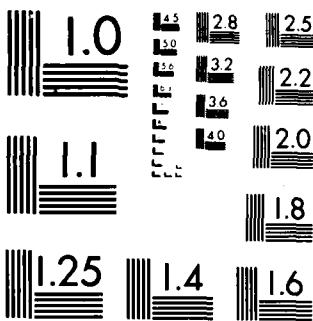
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VITA

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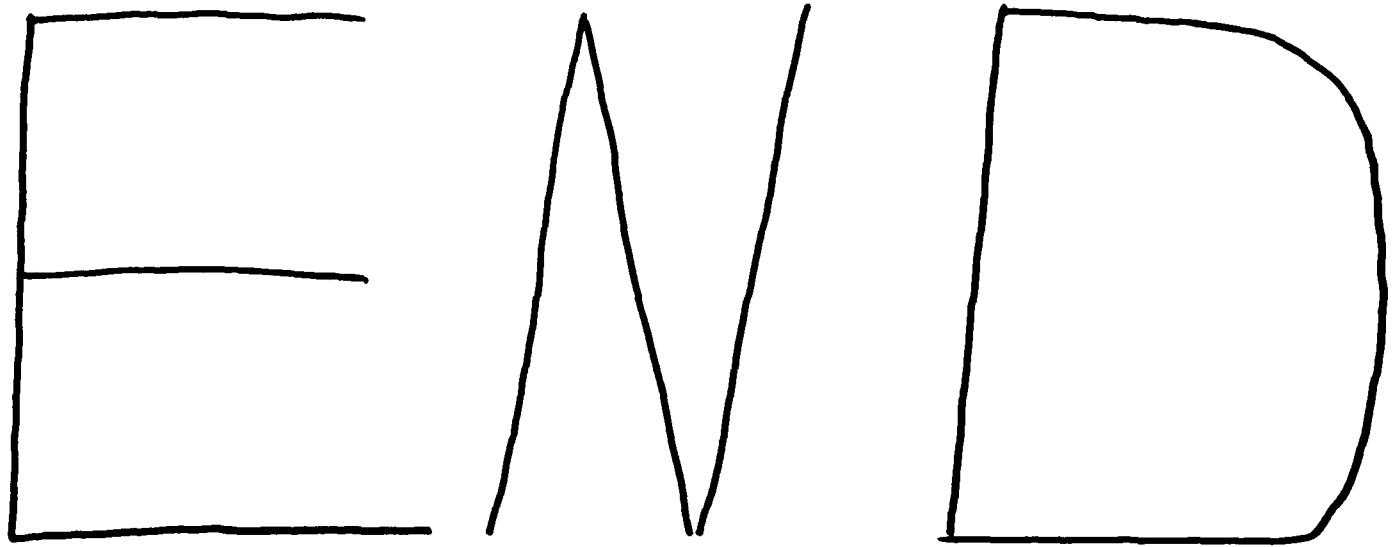
This investigation examined the interrelationships between four variables in research and development organizations within Air Force Systems Command. The four variables were the work unit supervisor's personality type, work unit structure, work unit communication flow, and work unit effectiveness. Data reduction was performed on an existing data base and 31 work units were identified. Values for the four variables were computed for each of the 31 work units.

A one-way analysis of variance was performed in order to look for significant differences in structure, communication flow, or effectiveness between different supervisor personality types. Significant differences were discovered between sensing types and intuitive types in the structure of their work units and in the quality of information received by their work units. In addition, significant differences were noted between thinking types and feeling types in the effectiveness of their work units. These findings may provide guidance for selecting managers in research and development organizations.

A Pearson correlation analysis was performed to look for significant relationships between structure, communication flow, and effectiveness. Significant relationships were noted between a work unit's structure and the quality of information it receives, and its access to that information. Also discovered were significant relationships between a work unit's structure and its effectiveness, and between a work unit's information quality and its effectiveness. These findings may prove useful in the design and redesign of research and development organizations.

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